CIVIL ENGINEERING

[illegible]

[illegible] [illegible] is built for erection of [illegible] [illegible] of new Belle Vernon, Pa., bridge. . . . See story by R. B. Howard.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

D. C. bridge sets record for plate-girder swing spans.............................. Engel

Thin precast concrete members form Turin Exhibition Halls.............................. Nervi

Houston plans Texas welcome for ASCE.............................. February 21—23

GOW SOIL BORINGS

BY Raymond

Carefully made soil investigations are of great value to Owners, Architects and Engineers in the selection of building sites and the determination of proper structural foundations.

Specify dependable Gow borings by Raymond and you will secure information that will supply the basis for sound engineering decisions.

Their low cost will surprise you.

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THE SCOPE OF RAYMOND'S ACTIVITIES includes, in addition to borings for soil investigation, every recognized type of foundation construction—concrete, composite, precast, steel, pipe and wood piles. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements, and cement mortar lining of oil and water pipe lines 4" to 144" in diameter by the Centriline Corporation, a Raymond subsidiary.

AROUND THE WORLD
FOUNDED 1897

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Raymond

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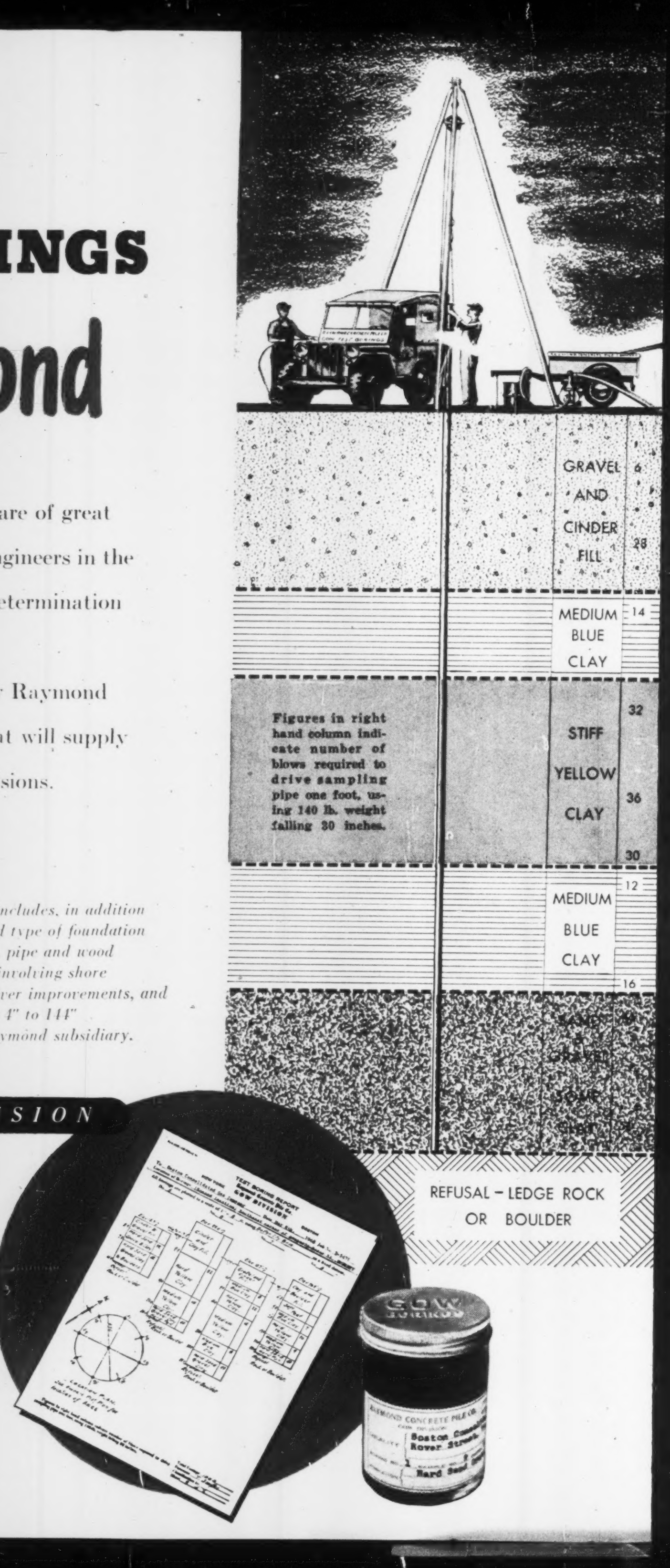

Figures in right hand column indicate number of blows required to drive sampling pipe one foot, using 140 lb. weight falling 30 inches.

GOW TEST BORINGS
GRAVEL AND CINDER FILL
6
28
MEDIUM BLUE CLAY
14
STIFF YELLOW CLAY
32
36
30
MEDIUM BLUE CLAY
12
16
SAND & GRAVEL SOME SILT
REFUSAL – LEDGE ROCK OR BOULDER
TEST BORING REPORT
GOW DIVISION
GOW BORINGS
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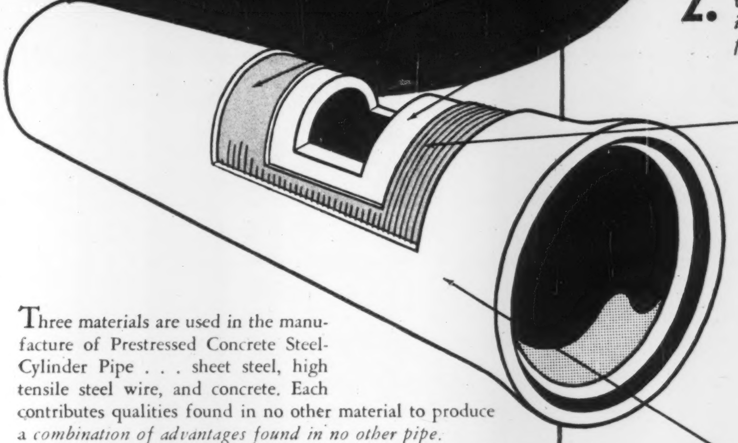
Hard Sand

HOW Prestressed Concrete Steel-Cylinder Pipe IS MADE



1. A STEEL CYLINDER . . . is formed and hydrostatically tested up to a tension in the steel of 25,000 psi. *(Steel cylinder provides high beam strength and water tightness.)*

2. A CONCRETE CORE . . . is formed inside the steel cylinder. This becomes a structural part of the pipe. *(Concrete lining provides initial and continued high rate of flow.)*

3. HIGH TENSILE STEEL WIRES . . . are wound around the steel cylinder and concrete core at constant tension. *(Steel wire prestresses steel cylinder and concrete core by compressing them. Compression is relieved as internal water pressure increases, thus permitting high operating pressures without tension in concrete.)*

4. A CEMENT MORTAR . . . encasement provides a permanent exterior jacket. *(Mortar has proven the most successful protection against corrosion and electrolytic action.)*

Three materials are used in the manufacture of Prestressed Concrete Steel-Cylinder Pipe . . . sheet steel, high tensile steel wire, and concrete. Each contributes qualities found in no other material to produce a *combination of advantages found in no other pipe.*

This combination produces water pressure pipe that will give the longest trouble-free service at the lowest cost. That's why Prestressed Concrete Steel-Cylinder Pipe was picked for one of America's *longest* high-pressure water supply lines—the Saginaw-Midland pipe line in Michigan, and for lines in Miami, Fla., Rochester, N. Y. and elsewhere. Prestressed Pipe is manufactured in sizes from 16″ up for any pressure common to American water-works practice.

Our engineers know pipe line design and laying problems. Consult them. There will be no obligation.

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PRICE Pressure PIPE
PRESTRESSED CONCRETE
STEEL-CYLINDER PIPE

Please send me booklets on Prestressed Pipe.

☐ Manufacturing and Prestressing
☐ Tapping under Pressure
☐ AWWA Specification No. 7B.2-T

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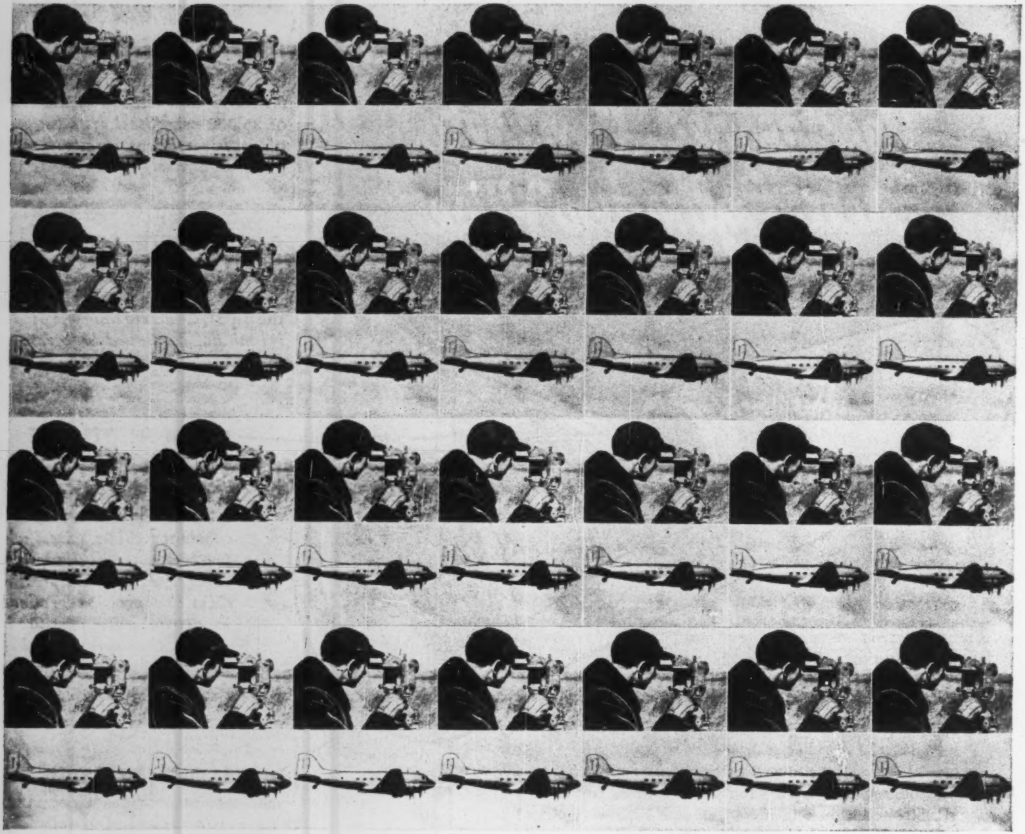
◀ Send for these fact-packed booklets on Price Brothers Prestressed Concrete Steel-Cylinder Pipe.

Installing Price Brothers Prestressed Pipe on the 80-mile Saginaw-Midland project, one of America's longest high-pressure water supply pipe lines. Elbows go into line easily and quickly. ▶

CIVIL ENGINEERING, The Magazine of Engineered Construction, January, 1951. Vol. 21, No. 1. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.



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From Single Items To Complete Sewage Treatment Plants INFILCO Equipment Can Fill ALL Your Needs

Thinking about replacing old equipment or modernizing and increasing the capacity of a sewage treating plant? INFILCO can provide a complete range of equipment and control devices from which to choose.

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SEND FOR *8-page Bulletin No. 60-C. It contains illustrated descriptions covering the many superior advantages of Infilco Sewage Treatment Equipment.*

PRECISION ENGINEERED INFILCO SEWAGE TREATMENT EQUIPMENT

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Quality Engineered for Quality Performance

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AND WASTE TREATMENT SINCE
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INFILCO INC.

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WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

THE MEMBERSHIP OF A C.I.P. Century Club now has

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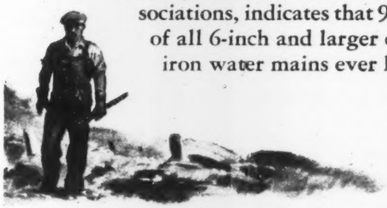
CAST IRON PIPE

DISTINGUISHED CLUB...
30 Members!

The Cast Iron Pipe Century Club is probably the most unusual club in the world. Membership is limited to municipal, or privately-owned, water and gas supply systems having cast iron mains in service for a century or more.

Although the Club is formally constituted, there are no dues, no regular meetings, and no obligations other than to inform the Recording Secretary if and when the qualifying water or gas main is taken out of service, or, sold for re-use.

In spite of the unique requirement for membership, the Club roster grows, year by year. And why not, when a survey sponsored by three water works associations, indicates that 96% of all 6-inch and larger cast iron water mains ever laid in 25 representative cities are still in service. And when answers to a questionnaire, mailed to gas officials in 43 large cities, show that *original* cast iron mains are still in service in 29 of the cities.



If your records show a cast iron main in service, laid a century or more ago, the Club invites you to send for a handsome framed Certificate of Honorary Membership. Address Thomas F. Wolfe, Recording Secretary, Cast Iron Pipe Century Club, Peoples Gas Bldg., Chicago 3, Illinois.

CLUB ROSTER

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CONSOLIDATED GAS ELECTRIC LIGHT & POWER CO.
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in modern plant design
• DEPENDABLE PROTECTION
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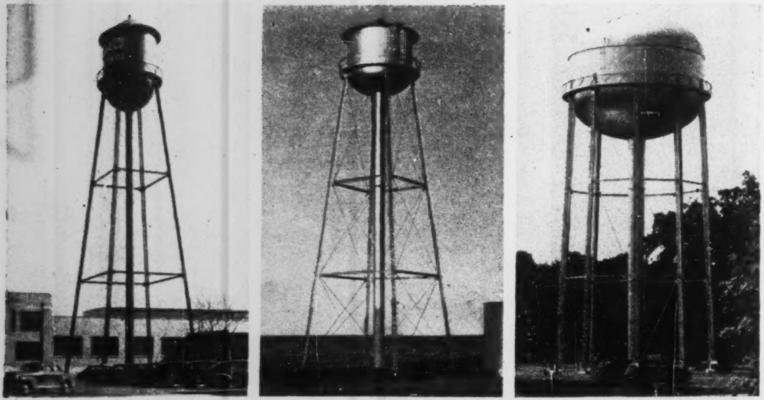

Elevated Steel Tanks

Choose the Pittsburgh-Des Moines Elevated Steel Tank meeting your precise requirements in type and capacity, and you will enjoy every benefit of safe and certain water supply—at lower cost —*with guaranteed dependability.* Write for our latest "Modern Water Storage" Brochure.

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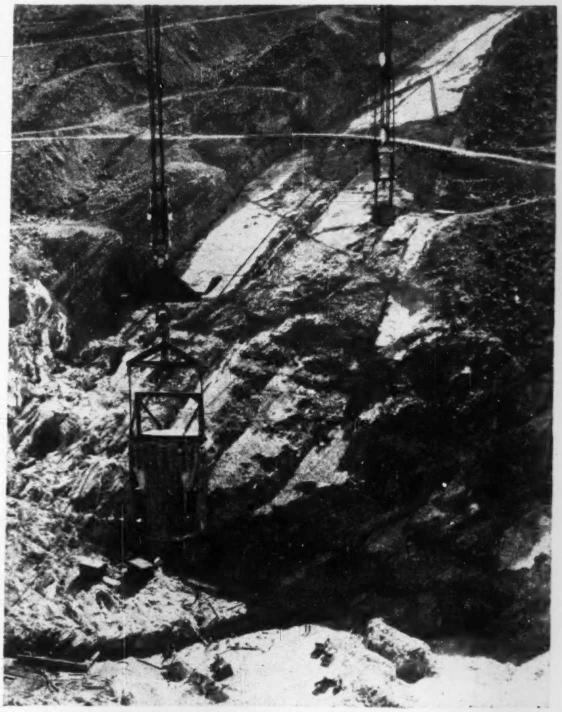
CHICAGO (3).....1274 First National Bank Building
DES MOINES (8)...............971 Tuttle Street
DALLAS (1)..............1275 Praetorian Building
SEATTLE..........................978 Lane Street
SANTA CLARA, CAL...............677 Alviso Road



BIG LIFT carries concrete across a canyon

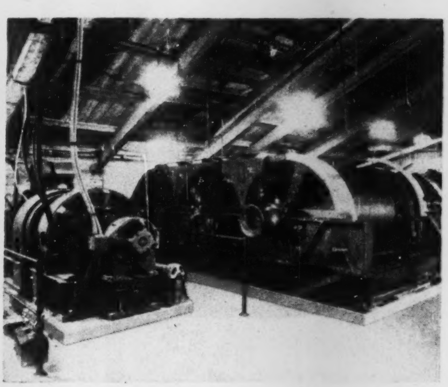
... Electrically

G-E Powered Aerial Cableways Vital Link in Concrete Placing at Hungry Horse Dam

Carrying 2,900,000 cubic yards of concrete across a half-mile canyon! It's only one of the big jobs at which the General Shea Morrison Construction Company works night-and-day to complete Hungry Horse Dam on schedule for the Bureau of Reclamation. But they're licking this and the many other problems that face them on the Flathead River site in northwestern Montana. Their answer lies in the use of co-ordinated electric equipment—G-E substations, motors, motor-generators, Cabinetrol*, and switchgear, carefully integrated into one complete system.

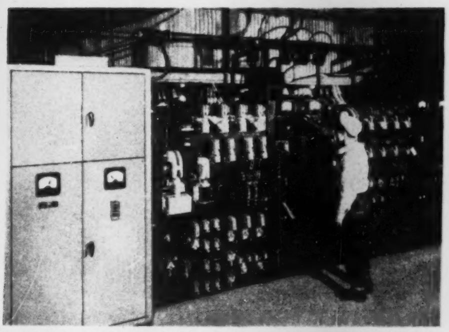
Construction equipment electrified by General Electric can provide *you* with new on-the-job flexibility, speed, and safety. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

**Reg. trade-mark of General Electric Co.*



▲ Aerial cableway hoist room showing hoist drums and one of three General Electric motor-generator sets used to drive the powerful G-E 500-hp hoist motors.

◀ Concrete in 8-cubic-yard buckets is moved nearly half a mile on a G-E powered aerial cableway for placing concrete in the construction of Hungry Horse Dam.



Attendant adjusts voltage on G-E switchboard panel. At left is G-E Cabinetrol. Installation provides variable voltage for smooth, accurate speed control of cableway hoists.

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

Electrified Construction
BETTER PRODUCT
LOWER COST

GENERAL ELECTRIC

664-14

GUTS

When two-legged people have guts, they finish the fight and do the job.

Real guts—that's what the world admires—man or machine.

You can't define what makes guts in a man, but you can "analyze" the fighting, working, dogged innards of the Champ. So let's put the X-ray on the TD-24:

Drawbar Horsepower: 148 working horsepower delivered at the drawbar in official tests.

Synchromesh Transmission: you "shift on-the-go," with eight speeds forward, eight reverse for faster time cycles with more pay dirt per cycle.

Instant Speed Change: up or down one speed without declutching.

Planet Power Steering: all turns are easier . . . pivot turns, feathered turns, turns with power on both tracks.

Reserve Torque: gives the Champ the lugging ability to fight through temporary overloads.

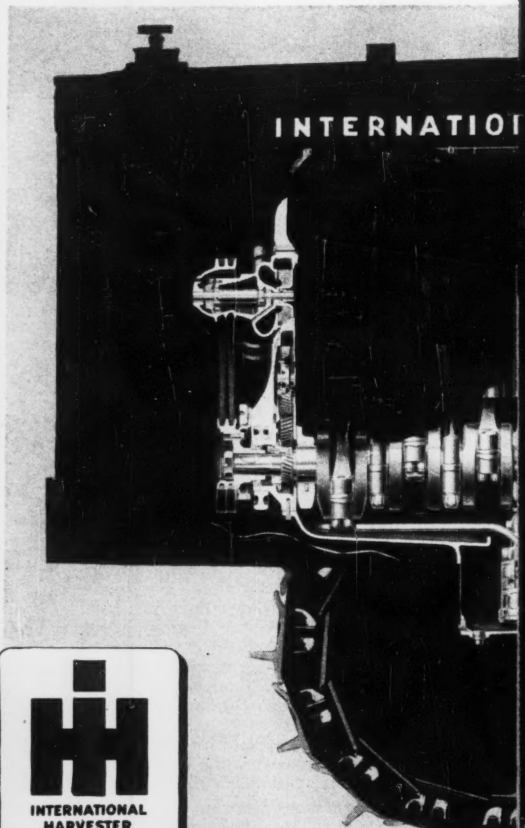
Easy Steering: finger-tip hydraulic controls.

All-Weather Starting: push-button, gasoline-conversion starting—an International exclusive—gets you on the job fast.

More Work: the TD-24 is doing more work—with more speed and more lugging ability—than any other crawler tractor on the market.

Look it over. Then ask your International Industrial Distributor to show you what it can do for you. You'll be a TD-24 man from then on in.

INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS



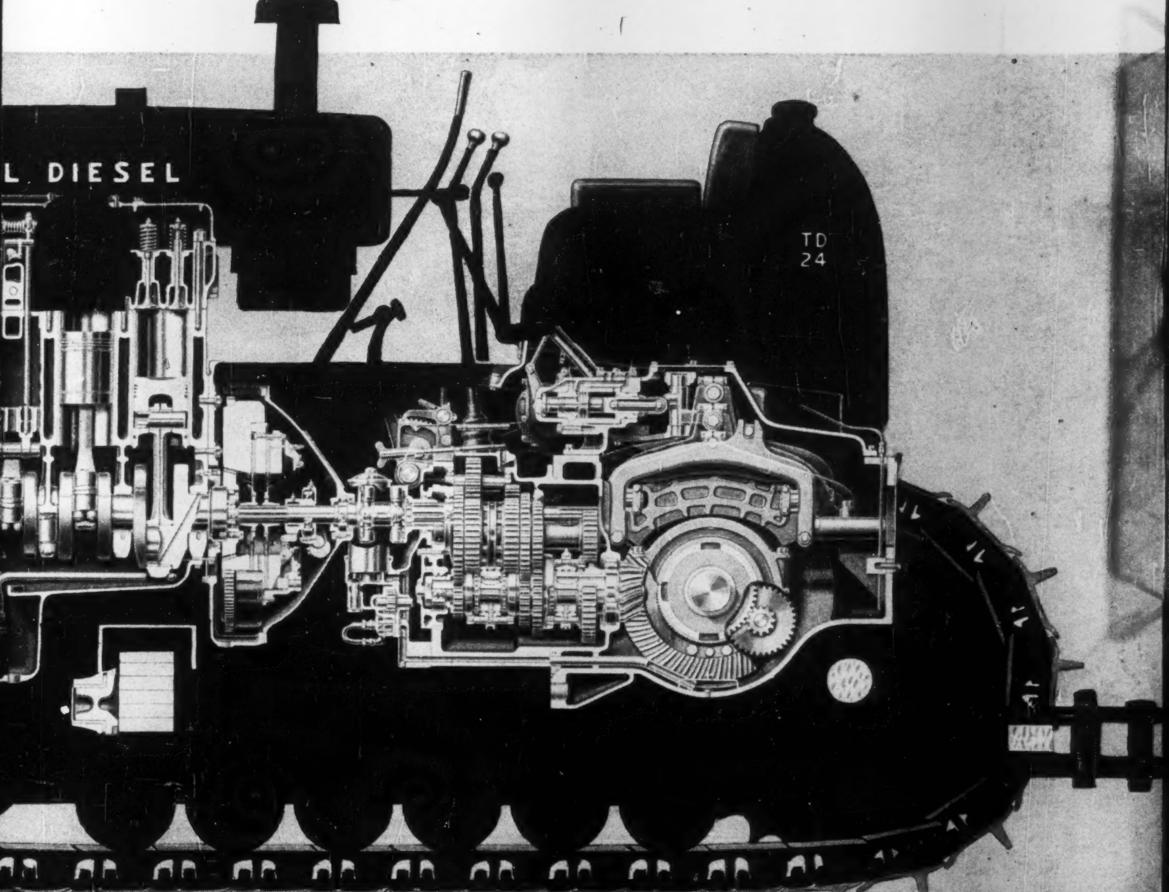
POWER THAT PAYS

INTERNATIONAL

INTERNATIONAL
HARVESTER

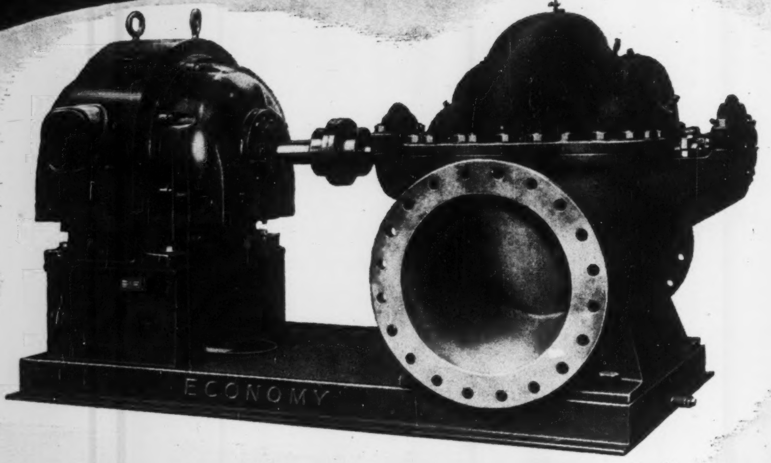
OF A CHAMP

inside story of the TD 24


L DIESEL
TD 24

when it's pumps, think of Economy

backed by over thirty years of specialized experience



The Type M Single Stage Double Suction Pump illustrated is just one of the many in the extensive line manufactured by Economy Pumps, Inc. This exceptionally rugged design is available in capacities from 50 to 30,000 gallons per minute at heads to 300 feet. A general purpose pump, it is ideally suited to general water supply or heavy mill service.

Maintenance expense is held to a minimum. Case records show Economy Pumps operating for fifteen to twenty years without replacement of major parts. However, should repairs be necessary, all parts subject to wear are renewable.

Economy Pumps are tested in accordance with the standards of the Hydraulic Institute and the A. S. M. E. under conditions duplicating as nearly as possible those encountered in actual service.

Catalog No. A750 gives complete design and construction details, also some interesting typical examples of performance, as well as handy selection tables. Write Dept. BK-1 for your copy.

Economy Pumps Inc.

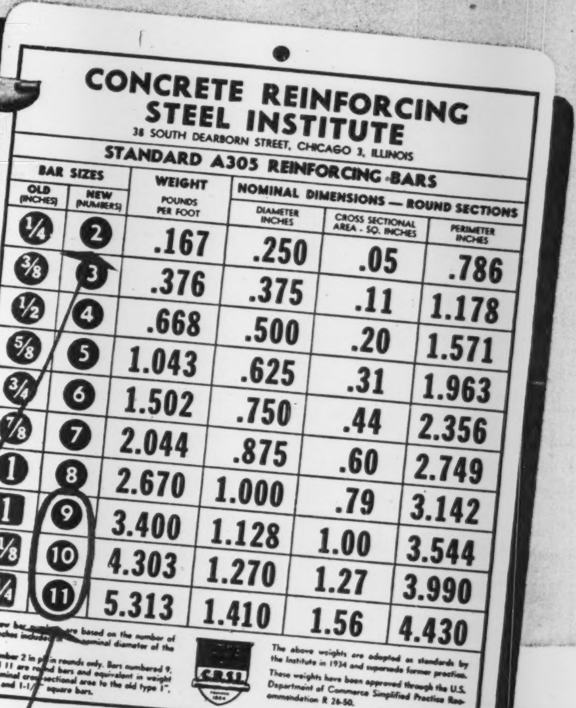
DIVISION OF HAMILTON-THOMAS CORP., HAMILTON, OHIO

Here's Complete Information on the

New NUMBERING SYSTEM

FOR A305 REINFORCING BARS

A new method of identifying reinforcing bars for size has recently been adopted by the steel industry. In this new system, bars are designated by numbers from 2 to 11. However, the new bars will have the same cross-sectional area as the old bars, so design tables, etc., will not need to be changed. The bar chart below explains the new designations.



CONCRETE REINFORCING STEEL INSTITUTE

38 SOUTH DEARBORN STREET, CHICAGO 3, ILLINOIS

STANDARD A305 REINFORCING BARS

BAR SIZES		WEIGHT	NOMINAL DIMENSIONS — ROUND SECTIONS		
OLD (INCHES)	NEW (NUMBERS)	POUNDS PER FOOT	DIAMETER INCHES	CROSS SECTIONAL AREA - SQ. INCHES	PERIMETER INCHES
1/4	2	.167	.250	.05	.786
3/8	3	.376	.375	.11	1.178
1/2	4	.668	.500	.20	1.571
5/8	5	1.043	.625	.31	1.963
3/4	6	1.502	.750	.44	2.356
7/8	7	2.044	.875	.60	2.749
1	8	2.670	1.000	.79	3.142
1	9	3.400	1.128	1.00	3.544
1 1/8	10	4.303	1.270	1.27	3.990
1 1/4	11	5.313	1.410	1.56	4.430

The new bar numbers are based on the number of 1/8 inches included in the nominal diameter of the bar.

Bar number 2 in plain rounds only. Bars numbered 9, 10 and 11 are round bars and equivalent in weight and nominal cross-sectional area to the old type 1", 1-1/8" and 1-1/4" square bars.

CRSI

1924

The above weights are adopted as standards by the Institute in 1934 and supersede former practice.

These weights have been approved through the U.S. Department of Commerce Simplified Practice Recommendation R 26-50.

NEW BAR NUMBERS

These denote the nominal diameter of the bar in eighths of an inch. Thus, a #3 bar (nominal diameter 3/8") has the same weight per foot as a 3/8" plain round bar. Bars #9, 10, and 11 are an exception to this rule. See details below.

NO MORE SQUARE BARS

Bars #9, 10, and 11 are round bars equivalent in weight and nominal cross-sectional area to the former 1", 1 1/8", and 1 1/4" square bars.

Write for Your FREE Copy of this New Bar Card

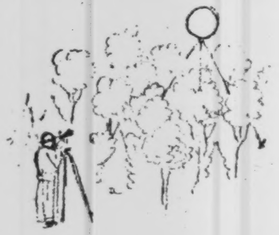
CONCRETE REINFORCING STEEL INSTITUTE • 38 S. Dearborn St., Chicago 3

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

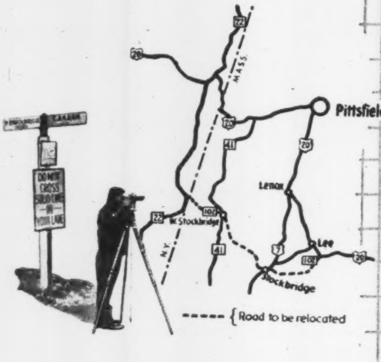
How would you solve this one?



A survey party preparing a highway location study at West Stockbridge and Stockbridge, Mass., faced the problem of getting initial lines between stakes separated by heavy timber. With no time for trial and error, J. R. Kelly, Chief of Party, suspended meteorological balloons—sometimes as high as 250 feet—over the far stakes. Pointing a Gurley Transit toward the balloons gave initial direction...close enough to cut through and obtain a line with minimum labor. Whenever a sight is impossible and cutting difficult, Kelly recommends a captive pilot balloon about 6 feet in diameter, filled with gas and guyed over the station point.

Transit Found Practical for "Checking In" on Precise Traverse Points—The special traverse on this study for a continuation of the Berkshire Thruway lay between two sections of a geodetic survey begun in the 1930's, but never completed. Field time was limited, but Kelly's party quickly established coordinates with the Gurley Transit, rather than with a theodolite usually used for tying in on a previously run precise traverse.

William J. Goggins, Survey Supervisor for the Commonwealth of Massachusetts, reports that error was negligible. His program calls for a relocation of Highway 102 —starting at the New York state line and running east to Stockbridge, eventually connecting into U. S. Highway 20 near Lee. Goggins' party had to run a 700-foot line over one mountain through which a tunnel is planned. "Check in" error was negligible, even though a 150-foot rise was encountered in the relatively short distance.



Gurley Transit's Reversion Level "Invaluable Aid"

In taping the line, the survey party used "slant measurements," taking also the difference in elevation between points. For this work, Goggins found the reversion-type level vial on the Gurley telescope "invaluable...easily read at all times." Checking the bubble in the Gurley reversion vial requires two readings only–one direct, and one reversed. Goggins says, "I am glad to have the Gurley Transit at this time...work will be very accurate...error practically eliminated."

Take a tip from William Goggins' notebook...Learn about versatile Gurley Transits. Bulletin 50 gives all details. Write for it today.

SURVEYORS: We welcome letters on your unusual solutions of surveying problems for future pages in The Surveyor's Notebook.

W. & L. E. GURLEY, 518 FULTON ST., TROY, N. Y.

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments, Meteorological Instruments.

GURLEY

Surveying and Scientific Instrument Makers
Since 1845

New tool steps up production

"CATERPILLAR" MOTOR GRADER
WITH DOMOR ELEVATOR
ATTACHMENT AVERAGES
40 TO 50 LOADS PER HOUR

Now the versatile "Cat" Motor Grader is more useful than ever. With the new DoMor Elevator Attachment, it becomes a one-man Elevating Grader that steps up casting and loading and steps down costs.

Here you see a "Cat" No. 12 Motor Grader with the DoMor Elevator at work in a stone quarry in Kentland, Indiana, for the Moellering Construction Co., Fort Wayne. The vein of rock varies from shallow to complete drop-offs. The "Cat"-DoMor unit is stripping overburden and loading it into trucks at the rate of 1 every 35-45 seconds. One day's production averaged about 440 loads in 10 hours. There is also a 1½ yd. shovel on the job. E. O. White, Superintendent, says: "We have 35 trucks on the job and they can't keep up with the DoMor. It has produced more than 2 loads to 1 over the shovel."

For information about this new tool, see your "Caterpillar" dealer. With the increasing use of "Caterpillar" equipment both for military needs and for maintaining the civilian economy, it's a good move to see him today. Talk over your needs. He has a complete stock of parts to keep your present equipment in running order and will do his utmost to make prompt delivery of new machines.

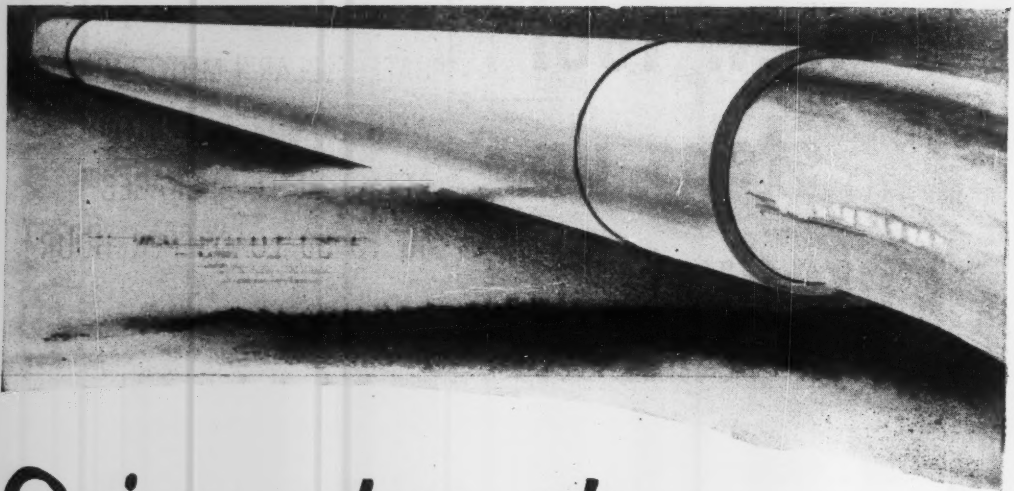
CATERPILLAR, PEORIA, ILLINOIS

FAST FACTS

- ★ **The DoMor Elevating Grader Attachment works with "Cat" No. 12 or No. 112 Motor Graders.**
- ★ **One-man operation from the operator's seat. Regular blade controls operate grader actions.**
- ★ **30-in. plowing disk cuts furrow just outside the wheel line.**
- ★ **Big-capacity 42-in. carrier runs at 400 ft. per minute.**
- ★ **Conversion from Motor Grader to Elevating Grader and vice versa gives you a double-purpose unit.**

CATERPILLAR

DIESEL ENGINES • TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT



Saving precious water for a thirsty

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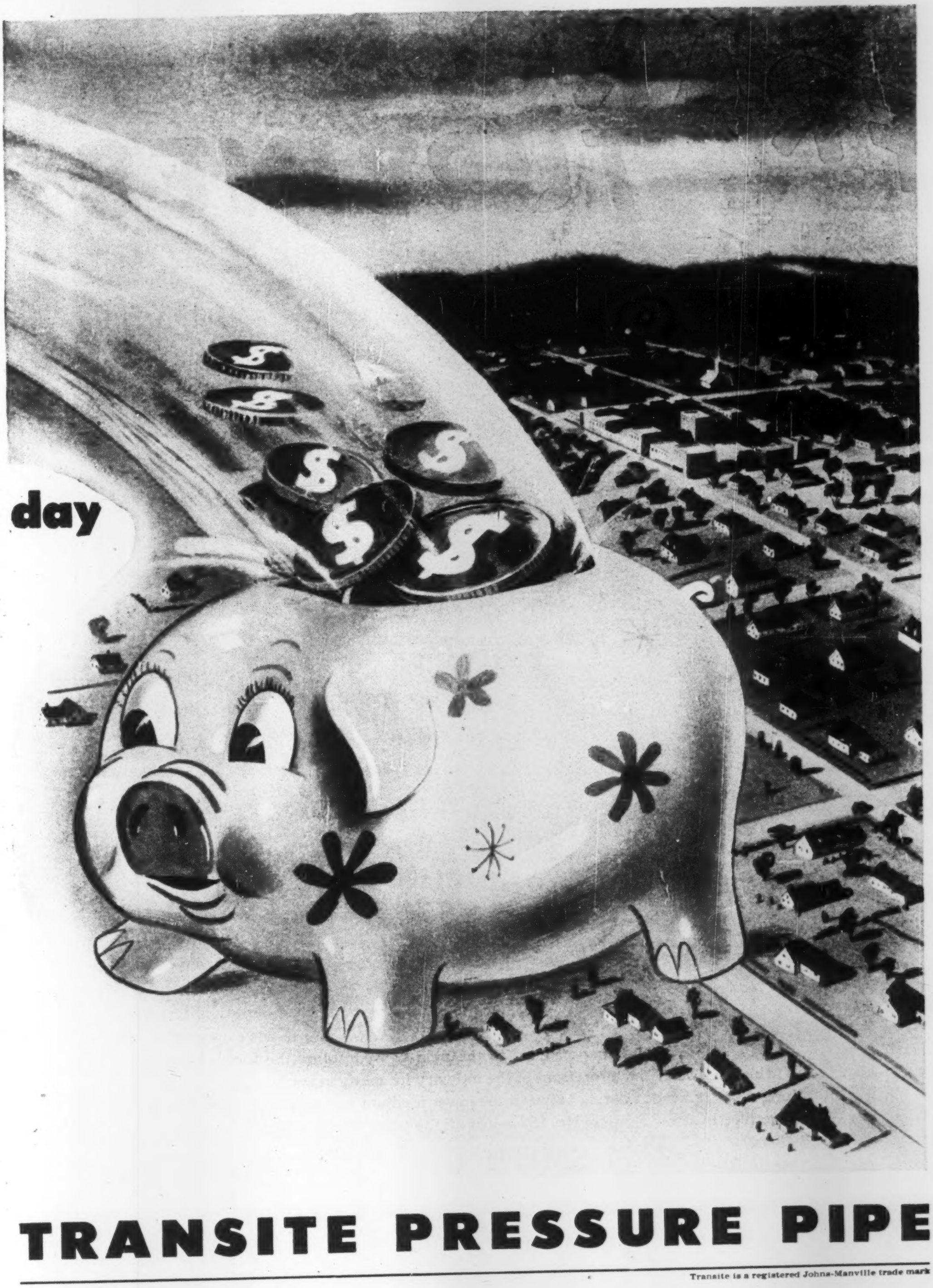

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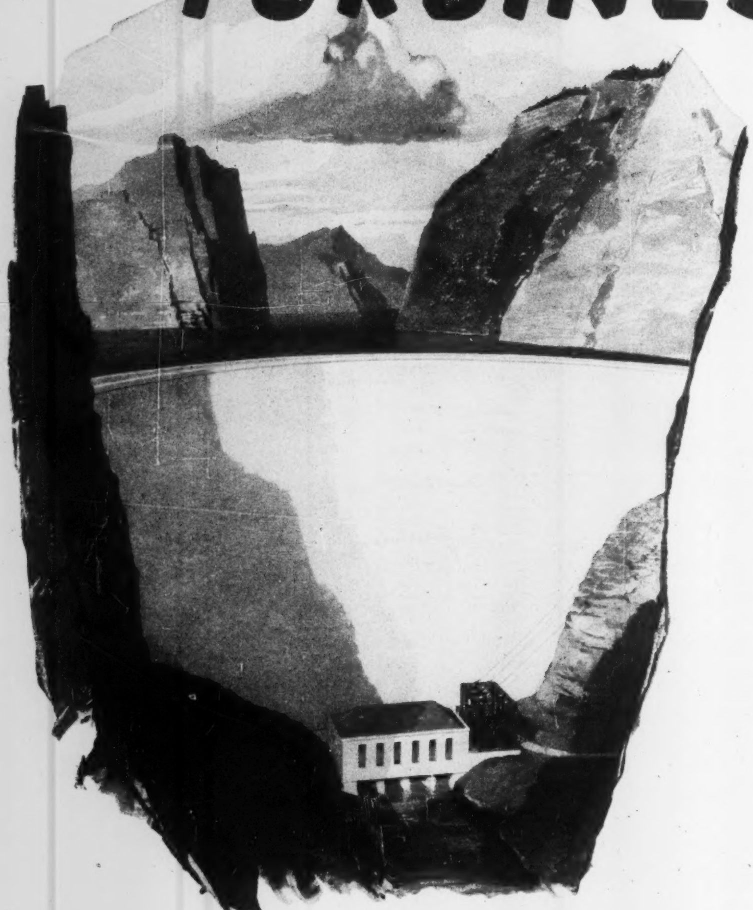

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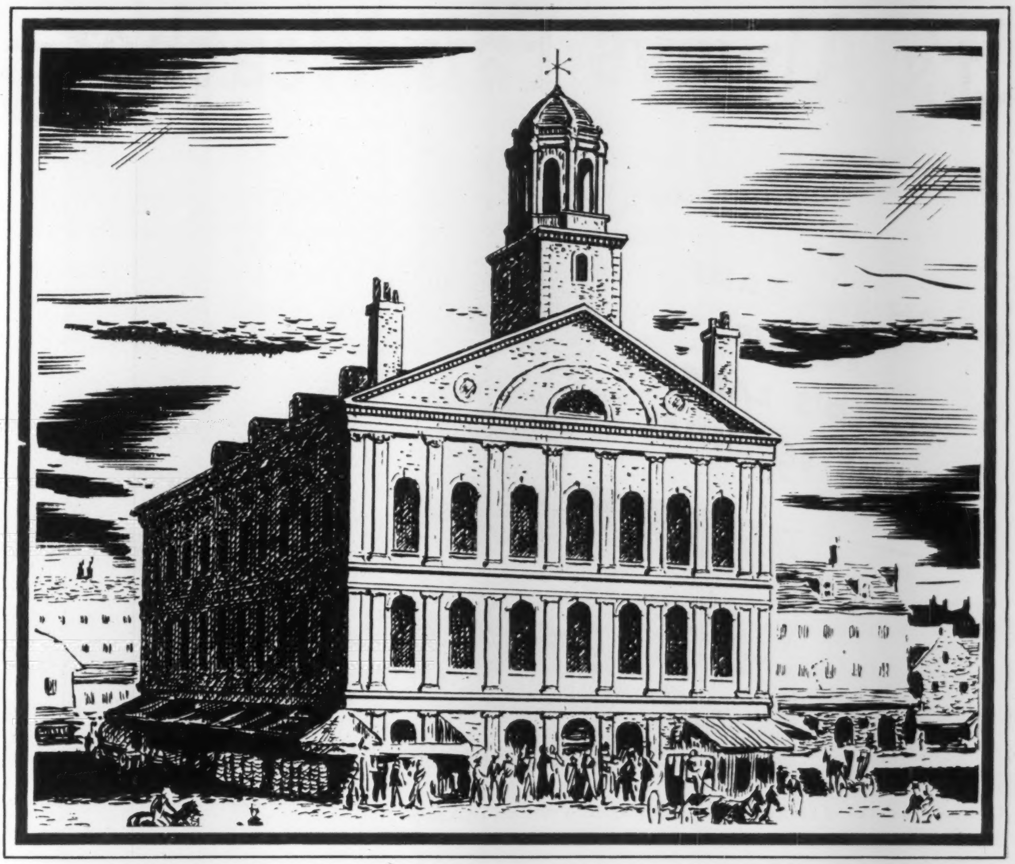

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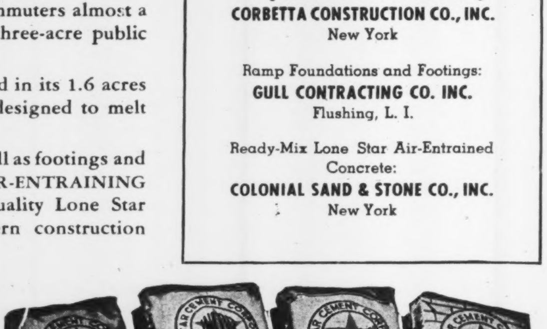
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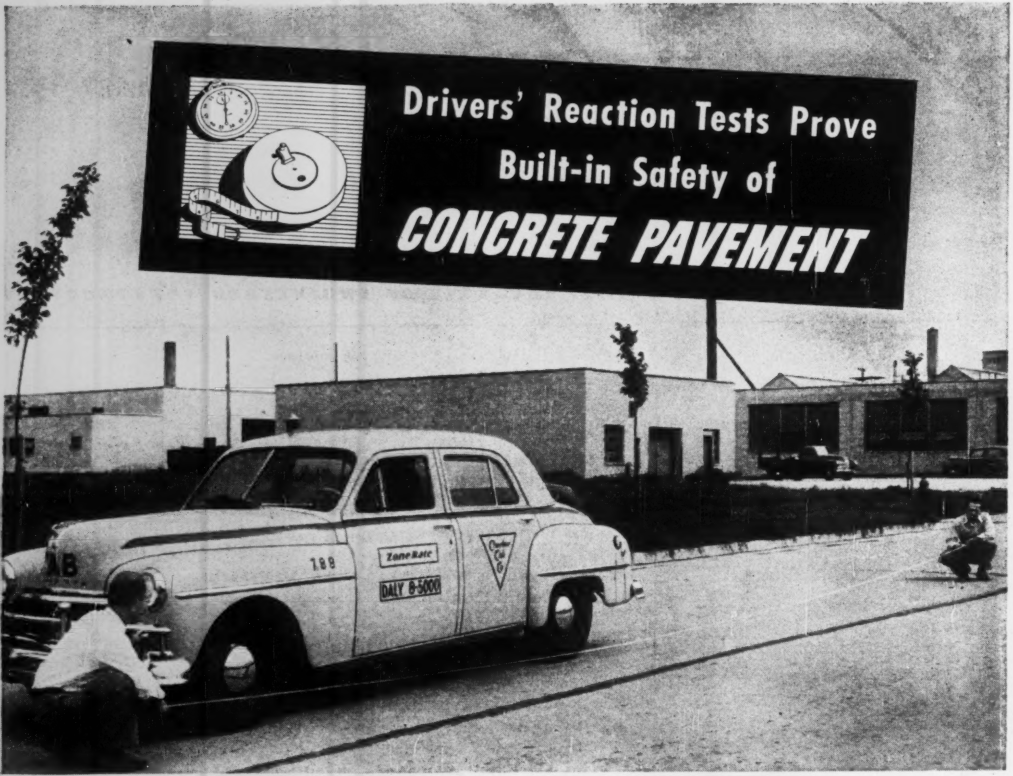

Drivers' Reaction Tests Prove Built-in Safety of CONCRETE PAVEMENT

SINCE May 1948, the Checker Cab Co. of Milwaukee has been giving its drivers a unique reaction test. The results have proved that drivers can stop quicker on concrete than on other pavements.

To make this test, two tiny guns are mounted on the test car—each loaded with a blank cartridge and capsule filled with yellow chalk. Frank Loh, who conducts the tests, rides beside the driver and fires one gun without warning. The exploding cartridge drives the chalk-filled capsule against the pavement, leaving a yellow mark.

The explosion is the signal to stop. When the driver applies the brakes the second gun automatically fires, leaving a second yellow mark. The distance between marks is the number of feet traveled before applying the brakes. The distance between the second mark and the front bumper of the halted vehicle is the number of feet required to stop.

Mr. Loh says, "These tests prove that at 20 miles per hour a car can be brought to a full stop 8 to 10 ft. sooner on concrete pavement."

These tests confirm what millions of motorists learn about the superior stopping power of concrete when they must stop quick in an emergency. Drivers soon learn, too, that they can be more relaxed when driving on concrete because of its other built-in safety features: (1) its gritty surface, which has uniformly high skid resistance, wet or dry, (2) its light color, which reflects more light at night, thereby increasing visibility during the most dangerous driving hours and (3) its freedom from hazardous ruts, bumps and chuck holes.

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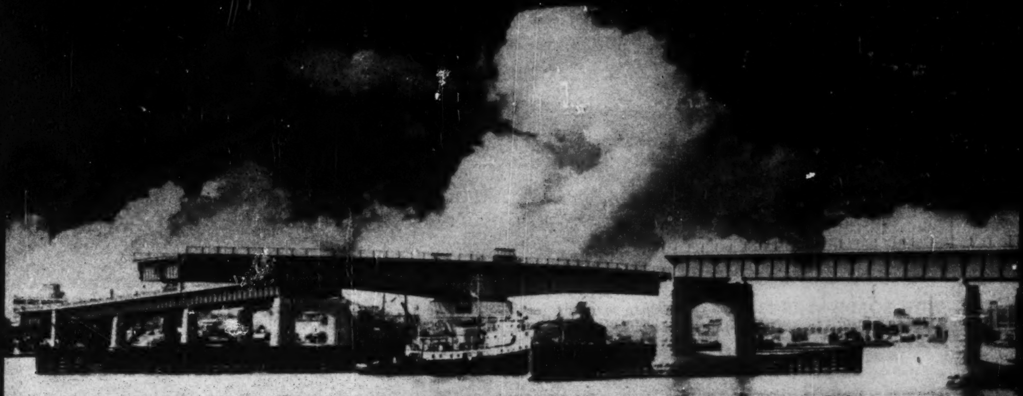
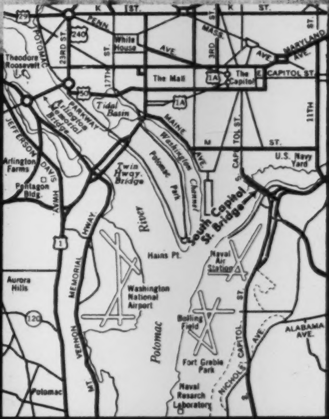


Record swing span characterizes South Capitol Street Bridge

HARRY J. ENGEL, M. ASCE

Modjeski & Masters, Harrisburg, Pa.

SWING SPAN of South Capitol Street Bridge, 386 ft in over-all length, is protected by center fender longer than span. Rest piers are likewise protected. Vertical navigation clearance of 45 ft permits most small vessels and tows to pass without opening span.


K
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ST.
29
PENN.
240
White House
AVE.
MASS.
3RD
AVE.
MARYLAND AVE.
ST.
POTOMAC
23RD ST.
ST.
Theodore Roosevelt
17TH
The Mall
1A
The Capitol
E. CAPITOL ST.
50
1A
PARKWAY
Arlington Memorial Bridge
Tidal Basin
MAINE
11TH
JEFFERSON
Washington
Potomac
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TOL ST.
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Channel
Pentagon Bldg.
HWAY
HWAY.
River
South Capitol St. Bridge
1
Hains Pt.
Naval Air Station
MEMORIAL
Aurora Hills
Washington National Airport
ST.
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Bolling Field
ALABAMA AVE.
VERNON
Potomac
CAPITOL
AVE.
Fort Greble Park
NICHOLS
MT.
Naval Research Laboratory
Potomac

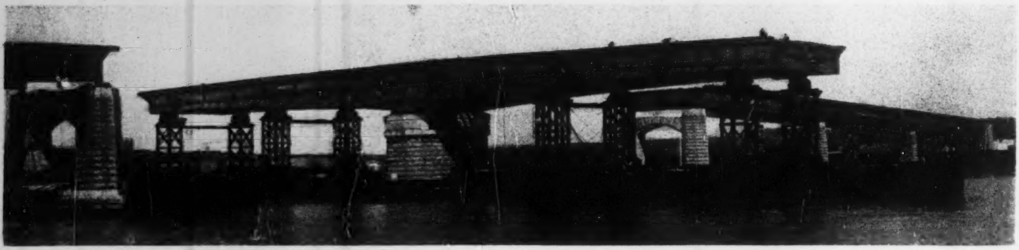
FIG. 1. MAP shows location of bridge spanning Anacostia River about one mile above its confluence with Potomac.

THE WORLD's longest plate-girder swing span is incorporated in the new South Capitol Street Bridge in Washington, D.C. Completed in December, 1949, this four-lane highway bridge crosses the Anacostia River about one mile above its confluence with the Potomac (Fig. 1). It serves the expanding southern area of Washington along the east bank of the Potomac River and also connects with the Suitland Parkway leading into Maryland.

Records indicate that since the opening of this bridge early in 1950, traffic on the formerly overcrowded 11th Street Bridge over the Anacostia, less than a mile upstream, has been reduced 36 percent.

Design of the new bridge was actually started in the spring of 1942, when a competition was held to determine the most suitable design for the limiting conditions at the site. Since the U. S. Naval Air Station and Bolling Field are both on the Anacostia side of the river downstream from the site, it was required that the bridge be as low as possible with the least possible projection above the handrail. A vertical navigation clearance of 45 ft was required so that most of the small vessels and tows could pass without the necessity of opening the movable span. At the same time, two 150-ft clear horizontal swing-span openings of unlimited vertical clearance were required for access to the Naval Gun Factory, just above the bridge site. The bascule and vertical-lift types of movable bridges were ruled out because of their height and consequent interference with air travel.

The winning design (Fig. 3), submitted by Modjeski and Masters, consulting engineers, with Paul P. Cret as consulting architect, embodies a 386-ft girder swing span supported on a circular center pier and flanked on each side by three cantilever girder spans of 152-ft span. As required by the moments, the swing girders are deepest at the pivot pier, varying from 18 ft 10 $^7/_8$ in. back to back of angles at this point to 10 ft $^1/_2$ in. back to back of angles at the ends, where



WITH ROADWAY IN PLACE, swing span is ready for finishing touches, such as railing and lamp standards, which were limited to height of 13 ft 6 in. to avoid danger of collision with airplanes from nearby fields.

they meet the girders of the flanking spans, which are the same depth.

Girder-Type Swing Span Adopted

It is appropriate here to quote from the preliminary report made on this structure on April 25, 1942:

> Comparative studies were made of designs for both truss and girder swing spans; and upon determination of the feasibility of the girder type and the fact that it was but little more costly than the truss type, it was adopted as being architecturally more suitable to the site and in better harmony with the proposed girder side spans. Moreover, the use of steel girders reduced the over-all height of bridge. . . . The curved shape of the bottom flange in the actual bridge is such that its chord is almost horizontal, so as to provide economically the vertical clearance required. . . .
>
> The swing bridge contemplated is of the center bearing type, with machinery on the span, electrically interlocked and controlled to permit continuous rotation in either direction. This control will permit the span to be swung away from river traffic approaching either span in either direction, thus speeding the time of opening and closing.
>
> The swing bridge is designed with the center wedges and bearings mounted on the center cross girder, concealed behind the main girders. This design permits the pivot pier to be of relatively small diameter with consequent saving in cost, and by concealment of machinery enhances the appearance of the bridge, protects the machinery and reduces maintenance.

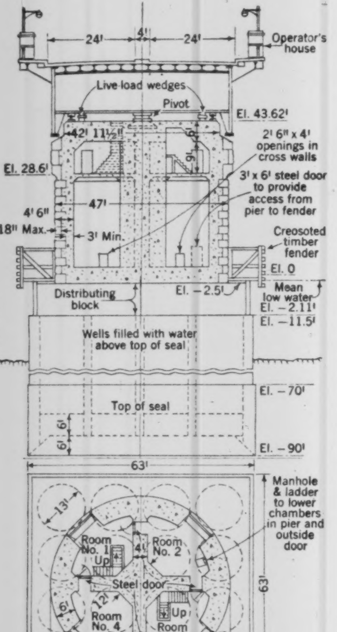


FIG. 2. PIVOT-PIER SHAFT is round, 47 ft in diameter and hollow above El. +2, considered to be above high water in river.

Based on this preliminary design and on final foundation borings, the contract plans for the bridge were prepared in 1942 and 1943, but actual construction could not be started during the war years.

Foundation borings revealed a clayey sand under most of the river piers. The pivot pier is founded at El. −90, and the other river piers at somewhat shallower elevations. The net additional foundation pressures were kept to about 2 tons per sq ft in excess of existing soil pressures, consolidation tests having revealed that the soils might suffer noticeable settlements under higher pressures. To insure reasonable uniformity in any settlements that might occur in the pivot and rest piers, the pivot pier, 63 ft square on its base, is restricted to 1.7 tons per sq ft of additional pressure above the existing soil pressure, while the comparable pressure under the smaller 22 × 77-ft rest-pier caissons is 2.3 tons per sq ft. Differential settlements among these piers, which might lead to faulty operation of the long swing span, have been negligible. Shims 2 in. thick are provided under the toggle shoes of the swing span and under the shoes of the flanking spans on the rest piers to permit adjustment in case differential settlements do occur.

Caissons for all the piers were designed with hollow wells for dredging. These wells were filled with water to equalize pressures after the tremie seals had been placed. Wells were capped with a concrete distributing block, and granite faced shafts were constructed above El. −5, about 3 ft below mean low water (Fig. 6).

Pivot Pier Has Diameter of 47 Ft

The pivot-pier shaft (Fig. 2) is round, 47 ft in diameter, and hollow above El. +2.0, which elevation was considered to be above high water on the Anacostia River. The upper story of this pivot-pier shaft contains switchboard equipment and lavatory facilities, and is lighted by large windows in each quadrant which contribute to the attractiveness of the design.

The outer wall of the pivot-pier shaft is 4 ft 6 in. thick, including the stone facing. Cross walls 4 ft thick divide the interior of the pier into four compartments. The swing-span pivot rests over the intersection of these cross walls on a block of concrete 12 ft square, and its load is distributed over the walls to some extent by a 6-ft-thick reinforced concrete cap.

Creosoted timber pile fenders protect the pivot pier and the two rest piers. The pivot-pier fender has sufficient width and length both upstream and downstream to protect the swing span in the open position. Since the swing span had to be erected in the open position, some of the fender piles were used to carry the falsework for erection.

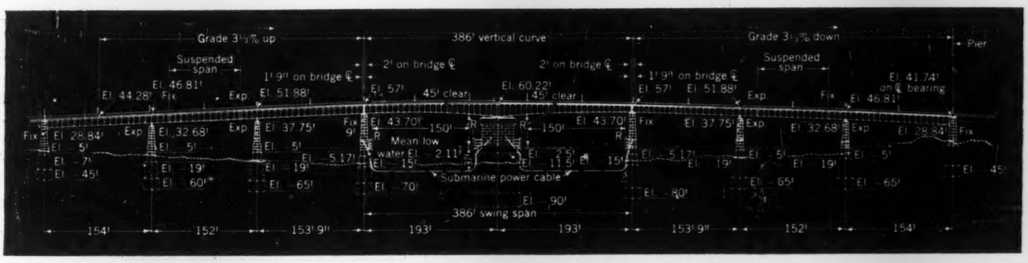

Grade 3⅓% up
386' vertical curve
Grade 3⅓% down
Pier
Suspended span
2' on bridge ℄
1' 9" on bridge ℄
El. 46.81'
El. 44.28'
Fix
Exp.
El. 51.88'
El. 57'
45' clear
El. 60.22'
El. 41.74' on ℄ bearing
El. 28.84'
El. 32.68'
El. 37.75'
El. 43.70'
150'
R
9'
Mean low water El. −2.11'
El. −5'
El. −7'
El. −45'
El. −19'
El. −60'
El. −65'
El. −5.17'
El. −15'
El. −70'
El. −2.5'
El. −11.5'
El. −80'
El. −90'
Submarine power cable
386' swing span
154'
152'
153' 9"
193'

FIG. 3. **DESIGN** embodies 386-ft girder swing span flanked on each end by three cantilever girder spans each 152 ft long.

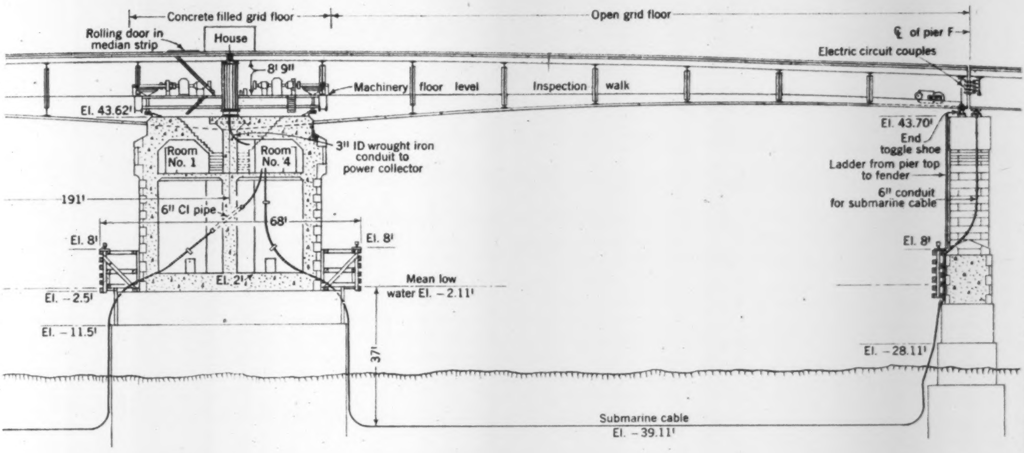
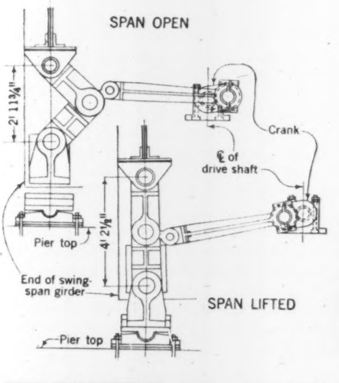
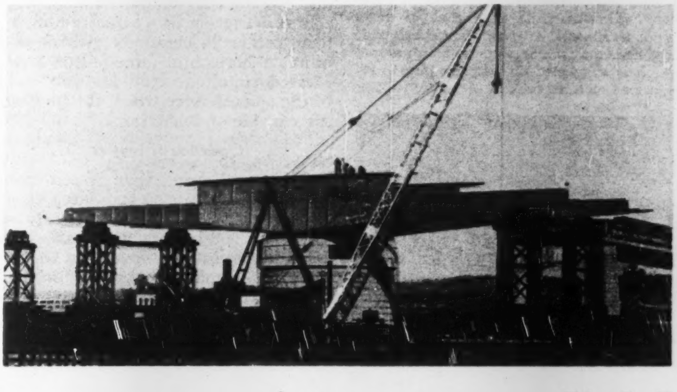

Concrete filled grid floor
Open grid floor
Rolling door in median strip
House
8' 9"
Machinery floor level
Inspection walk
℄ of pier F
Electric circuit couples
El. 43.62'
El. 43.70'
End toggle shoe
Room No. 1
Room No. 4
3" ID wrought iron conduit to power collector
Ladder from pier top to fender
6" conduit for submarine cable
191'
6" CI pipe
68'
El. 8'
El. 2'
Mean low water El. −2.11'
El. −2.5'
El. −11.5'
37'
El. −28.11'
Submarine cable El. −39.11'

FIG. 4. **TOTAL DEAD LOAD** on 36-in.-dia phosphor-bronze center pivot is 2,617 kips. Two 60-hp motors operate span.

FIG. 5. **TOGGLE DEVICE** (below) under each end of swing span raises span ends to position. Switch makes electrical contact when end of span is within 3½ in. of center line, turning on white light in operator's house to inform him that interlocks are set, ready for driving of toggles.


SPAN OPEN
2' 11¾"
Crank
℄ of drive shaft
4' 2⅛"
Pier top
End of swing-span girder
SPAN LIFTED
Pier top

CONSTRUCTION of swing span in open position was carried out after fenders had been placed, hence some of fender piles could be used to support falsework.



Intermediate piers under the flanking spans have twin shafts to support the two lines of girders. The two rest piers and the two bank piers have two shafts with connecting arches, the arch on the bank piers being required to support the interior girder of the three lines of girders which are used on the approaches. All the piers are attractively faced with granite which was quarried at Deer Island, Me.

The District of Columbia approach is a steel girder viaduct on steel bents carried on spread footings. The Anacostia approach is also of the steel girder type, but it is divided into three ramps and is supported on concrete piles driven through hard clay into a stratum of clayey sand.

Bids for the substructure were received on October 4, 1945, and the contract was awarded to the Dravo Corporation. Construction of the foundations for the bridge was described by Kenneth C. Cox, Jun. M. ASCE, Engineer, Dravo Corporation, Pittsburgh, Pa., in CIVIL ENGINEERING for December 1946.

Swing Span Arms 193 Ft Long

Much of the interest in the South Capitol Street Bridge centers in the record-breaking girder swing span and the manner in which it has been blended into the design of the bridge as a whole. The 193-ft arms are of course flexible under the mechanical operation of lifting their ends to counteract $1^{1}/_{2}$ times the theoretical live-load uplift. The required uplift per girder is 46 kips for this purpose and the movement is $3^{3}/_{16}$ in. For seating the ends of the swing span, a wedge bearing and an eccentric device were studied, but only a toggle device proved practical (Figs. 4 and 5).

ABUTMENTS AND PIERS on ramp approaches are faced with random coursed granite ashlar, trimmed with dressed limestone. On Anacostia side, each of three ramps terminates, as shown in background, in stone-faced cellular concrete construction, which is supported on concrete piles to relieve load on filled ground.

The total vertical movement of the end toggle shoes was $14^{3}/_{4}$ in. composed of the following elements:

1. Elastic droop of end of span before raising by toggle to compensate for $1^{1}/_{2}$ times possible live-load uplift	$3^{3}/_{16}$ in.
2. Balance wheels of turntable on pivot pier are set with $^{1}/_{16}$-in. vertical clearance above track. An additional deflection of $^{1}/_{16}$ in. may occur in the beam framing which supports these balance wheels. As a result, total raising or lowering of one end due to tilting from balance wheels could be	$1^{1}/_{4}$ in.
3. Droop of girder ends resulting from assumed 10-deg higher temperature in top flange than in bottom flange	$1^{1}/_{8}$ in.
4. Vertical swinging clearance	$2^{15}/_{16}$ in.
Total	$8^{1}/_{2}$ in.
Notch in toggle shoe	6 in.
Toggle-shoe grade correction of $3^{1}/_{3}$ percent	$^{1}/_{4}$ in.
Total required vertical movement of toggle shoe	$14^{3}/_{4}$ in.

Because of the length of the swing span, some consideration was given to the horizontal deflection that would result from the heat of the sun shining on one girder only, with a differential temperature between girders of 50 deg. Such a temperature variation would cause an apparent transverse deflection in each leaf of $1^{1}/_{2}$ in. If both leaves were to be deflected this amount, a conventional end latch, in which a wheel drops into a lower casting to lock the span in position, would not permit the required $1^{1}/_{2}$-in. latitude in either direction. Accordingly, to have positive centering, the conventional end latch was abandoned, and the toggle at the four uplift points was designed with transverse wedging action to straighten 1 in. of this theoretical movement and at the same time allow $^{1}/_{2}$ in. off center (Fig. 5). To remove 1 in. of horizontal deflection in a structure 48 ft from center to center of girders requires a horizontal force of 160 kips exerted simultaneously at each end of the span, a force which the toggles are capable of delivering.

Operation of Toggles

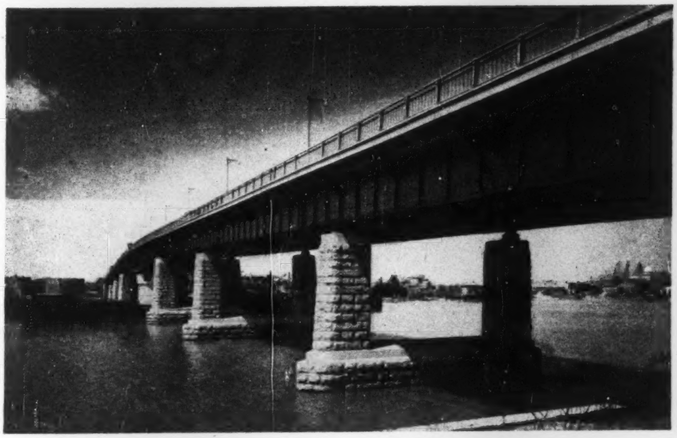
The usual swing span is centered by the conventional end latch, the dropping of which automatically stops the span. When in this case the latch was rejected in favor of a toggle shoe, it became necessary to devise a means of informing the operator when the span was sufficiently close to the center line for driving the toggles, and at the same time to so interlock the controls that the toggle shoes could not be driven at any other time. This aim was accomplished by providing a centering switch on each end which was actuated by an arm 1 ft 6 in. long striking a projecting bar on the flanking-span floorbeam on each end. Only when a span end is within $3^{1}/_{2}$ in. of the center line will this switch make electrical contact, and only when both ends are within $3^{1}/_{2}$ in. of span center will a white light go on in the operator's house to inform him that the span is in position, and the interlocks set, ready for driving of the toggles on each end of the span. These toggles are driven by a 15-hp motor acting through a crank.

The span is powered by two 60-hp 600-rpm synchronous-speed, 440-v motors operating two pinions, with a spare motor connected to each driving motor on the same shaft so that it can be cut in immediately. Alternative sources of power are available from the District of Columbia and Anacostia by submarine cable under the channel spans, so that if one source of power fails, the other can be thrown in instantly. Six collector rings above the center pivot carry this power up to the rotating span.

Controls for the roadway gates and traffic warning signals on the flanking spans are all centered in the operator's house on the moving span. These controls need only function when the span is closed, for all barriers and lights will have been set to stop traffic before the span can be opened. For that reason, the electrical conductors for the control of these traffic facilities are carried from the operator's house to a bank of fingers which are pushed up into position against conductors on the flanking spans each time the swing span ends are raised into closed position by the toggles. Power for actual operation of the gates and lights comes from the flanking spans.

Swinging roadway gates provide the first obstacle to traffic. The positive barrier one panel from the roadway break is a steel tee with an 8-in. flange which normally lies across a $6^{1}/_{4}$-in. roadway opening, stem down, but which rises out of the roadway on 4-in. pipes by electric power when the barrier is required for the opening of the span.

Although the roadway on almost all the bridge consists of an 8-in. reinforced concrete slab, the major part of the roadway on the swing span is a 5-in. open-grid floor to save weight. In the two central panels, over the important center machinery, switchboard and track, the swing-span roadway is a $4^{1}/_{4}$-in. filled grid with a $^{1}/_{4}$-



CURVED BOTTOM FLANGES of swing-span girders blend harmoniously into straight line of girders of flanking spans. Masonry piers are faced with granite.

in. concrete overfill. Sidewalks are 2-in. filled grid with $^1/_4$-in. concrete overfill.

The theoretical total deflection of the swing-span ends under full dead load was 13.81 in. below the cambered position in which the span was erected. When the span was first released from its falsework and before the steel-grid floor was placed, the span deflection was 9 in., which represented almost exactly the diminished theoretical amount under this partial load. This close agreement between the theoretical and the actual deflection of the swing-span ends is an indication of the excellent fabrication of the span by the contractor. A subsequent smaller deflection under the remaining load after the grid floor was placed, indicated, however, that the stiffness of the span had been somewhat increased on account of the attachment of the grid floor, and a small addition to the shims was made at the ends of the span to produce the correct elastic behavior for operation.

Center Pivot Dead Load

The total dead load on the center pivot is 2,617 kips. The dead load of the moving span is carried entirely on this 36-in. diameter phosphor-bronze center pivot except as wind or the forces of motor acceleration tilt the structure slightly and thus throw small reactions to the six balance wheels which ride on a track of 19-ft $6^1/_2$-in. radius. The cast steel track was made in 24-deg segments. Teeth to mesh with the pinion gears were cut on the outside of the track segments.

Live load at the center cross girder is carried in part by the pivot but principally by two wedge shoes, driven outward, which are mounted between the box cross girder and the pier (Fig. 2). These live-load wedges are driven after the span ends have been raised by the toggles. The wedges are driven by a 5-hp motor acting through a crank.

The section of the main swing-span girders, 18 ft $10^7/_8$ in. back to back of angles at maximum depth, consists of a $^{13}/_{16}$-in. web spliced horizontally at center of depth, four angles 8×8×1, four side plates 16×$^1/_2$, four side plates 8×1, and eight covers 24×$^7/_8$, all of silicon steel. The ends of the swing-span girders, and the flanking-span girders, have a single web 120 in. deep.

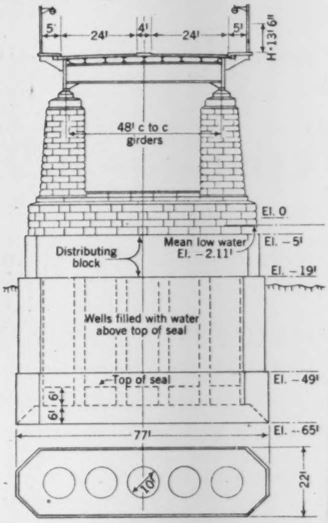
Stairs with a sliding cover for protection are provided in the median strip near the operator's house for access to the machinery floor and inspection walks under the deck, and to the cellular rooms of the pivot pier beneath that.

Bridge lighting is of the incandescent type. Lamp standards are restricted to a height of 13 ft 6 in. to minimize the danger of airplane collision.

Contractors and Designers

The contract for the superstructure was awarded to the American Bridge Company on the basis of bids received September 4, 1947. The Whiting-Turner Company was subcontractor to the American Bridge Company for paving, drainage and similar work.

FIG. 6. **CAISSONS** for piers had hollow wells for dredging. Granite faced shafts were constructed above El. −5, about 3 ft below mean low water.



The substructure bid by the Dravo Corporation was $2,487,590.00, and the superstructure bid by the American Bridge Company was $2,329,043.50.

The South Capitol Street Bridge was designed by Modjeski and Masters, consulting engineers of Harrisburg, Pa., with Paul P. Cret of Philadelphia as consulting architect. The design was made for the Department of Highways of the District of Columbia, for which H. C. Whitehurst was Director of Highways and C. R. Whyte was Bridge Engineer during the period of design and early stages of construction. On their death these two men were succeeded by J. N. Robertson as Director of Highways and H. R. Howser as Bridge Engineer, under whom the bridge was completed.

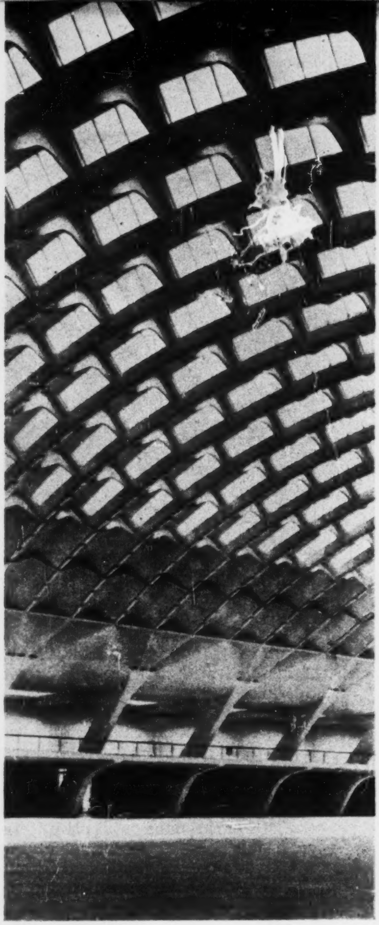
AT ANACOSTIA APPROACH, bridge divides into three ramps of steel trestle design, curved and superelevated. Longitudinal and tranverse forces are resisted by bending strength of columns.

Thin reinforced concrete members form Turin exhibition halls

Precast reinforced-mortar forms incorporated in structure

PIER LUIGI NERVI, Prof. Dott. Ing.
Nervi & Bartoli, Inc., Construction Engineers, Rome, Italy

DARING INGENUITY characterizes the design and construction of the recently completed Exhibition Center in Turin, Italy. Its owners invited engineering construction firms to submit designs as well as firm bids for the construction of three large exhibition halls. Dr. Nervi's plans, which were accepted, contemplated thin precast reinforced-concrete arch vault members. The arch ribs of the main Hall B, corrugated in cross section, have a span of over 260 ft; the diameter of the semicupola extension is 131 ft; and the ribbed pavilion vault over Hall C covers nearly an acre of floor space. By combining thin precast reinforced cement-mortar members with light cast-in-place reinforced concrete, conventional wooden forms were eliminated, erection time was shortened, and a strikingly pleasing structure was obtained. Where forms were needed, precast reinforced cement-mortar molds were used and incorporated in the structure. Light wooden falsework was supported by pipe scaffolding.



THE TURIN Exhibition Center consists of three large halls built in two stages. The first stage, Halls A and B with basement, was built between September 1947 and May 1948; and the second stage, Hall C, between November 1949 and April 1950. The relation of these halls to one another is shown in Fig. 1 (a) which represents the general plan, studied by Ing. R. Biscarelti on behalf of the Turin Exhibition Center.

Thin Precast Elements for Hall B

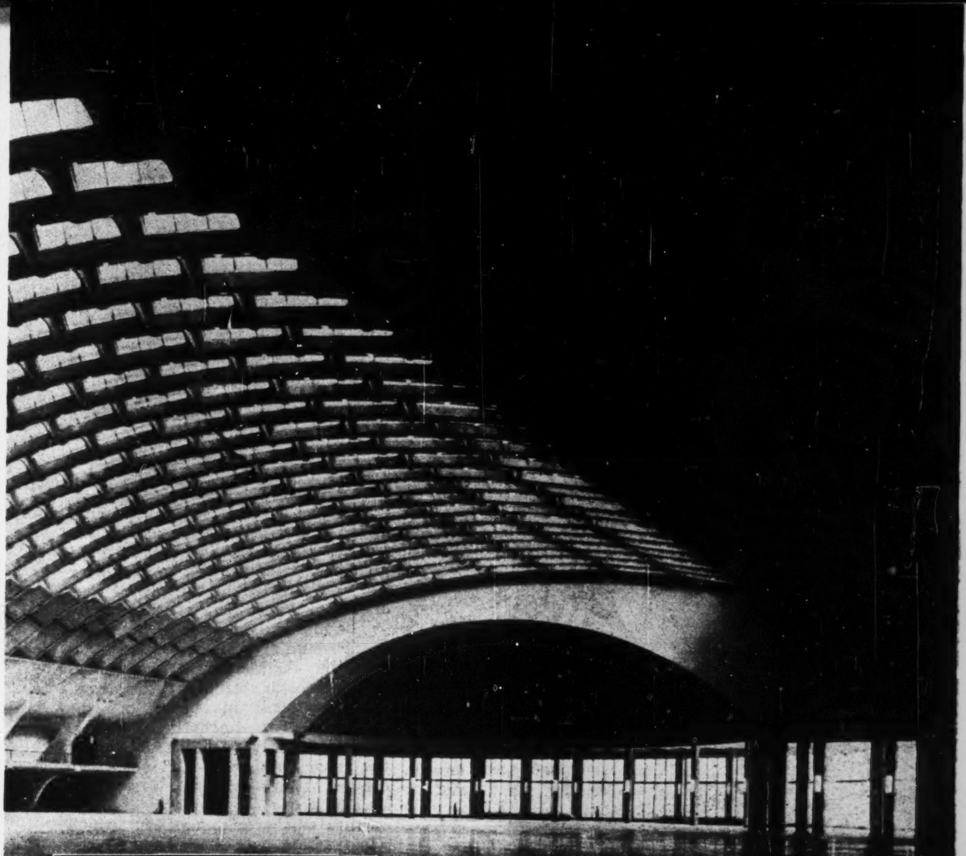
To solve the architectural, technical and economic problems involved in the construction of Hall B (Figs. 1 and 3), which provides nearly $2^{1}/_{2}$ acres of exhibition space, the Turin Exhibition Center invited several firms to submit detailed plans, including cost estimates, to be considered as committing the firm to build for the amount estimated. This method of closely coordinating the design, construction and economic aspects has many advantages.

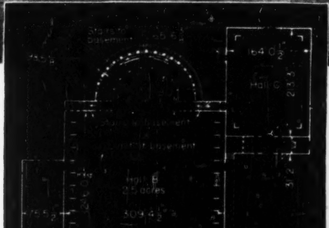
The main difficulties involved in the problem submitted to the various competitors were the large size of the hall, its extension into a semicircular plan prolongation, and the short time allowed for construction, more than half of which would be in winter months, anticipated to be very cold, with few days in which work could proceed. Furthermore, because of the large size of the hall, cost could be kept low only through design solutions utilizing light structural elements. Any excess of weight would result in a series of dead-load requirements and a corresponding increase in the amount of the materials used in the structure and its foundations.

Among several tentative solutions considered, a corrugated vault of 270-ft clear span for the front hall, and a semicupola with a 131-ft diameter with a 33-ft perimetrical ceiling for the back hall, appeared to be particularly applicable. This solution confronted the designer with structural and economic problems. First, there was the difficulty, cost and slowness of erecting the traditional wooden forms needed for reinforced concrete work; and second, there was the complicated shape of the members needed to best fit the load requirements.

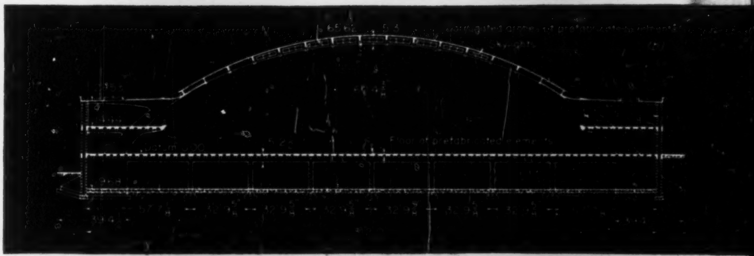
No Wooden Forms Needed

For these reasons I abandoned conventional reinforced concrete methods and made use of a special system of construction that I had developed some years ago for naval work. This system consists in making thin shapes ($^{3}/_{4}$ to 2 in. thick) reinforced almost uniformly with a network of steel bars having a small diameter ($^{3}/_{16}$ to $^{5}/_{16}$ in.) and mul-

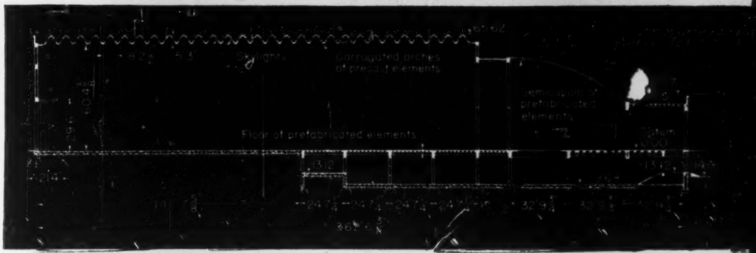




Stairs to basement
Hall C
Hall B
2.5 acres
Hall A
Theatre
Garden
(a)



Corrugated arches of prefabricated elements
Skylights
Floor of prefabricated elements

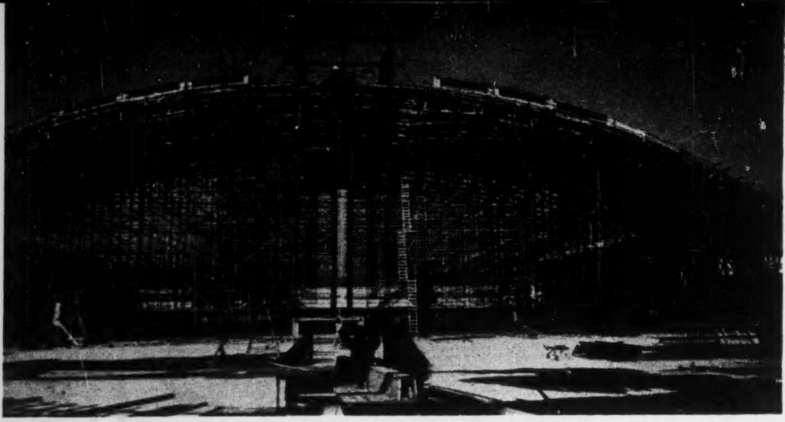


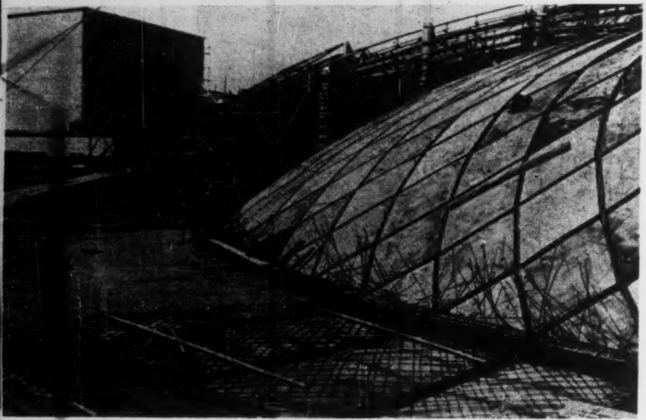
Skylights
Corrugated arches of precast elements
Semicupola of prefabricated elements
Floor of prefabricated elements

FIG. 1. **EXTENSIVE USE** of precast elements characterizes Turin Exhibition Center, seen in plan (a), above. At right are section through Hall B (*b*), and section through semicupola (*c*).

EXHIBITION HALL B is seen in photograph at top of page, with semicupola in background. Total enclosed space in this hall, including semicupola, is nearly $2^1/_2$ acres.

LIGHT TIMBER FALSEWORK is supported on pipe scaffolding and carries precast arch elements assembled for Hall B until they can be tied together with cast-in-place reinforced concrete.





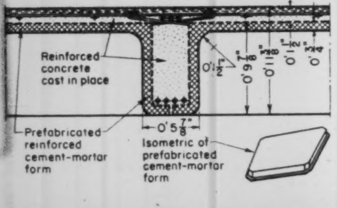

Reinforced concrete cast in place
0'1 1/2"
0'9 7/8"
0'11 3/8"
0'1 1/2"
0' 3/4"
0'5 7/8"
Prefabricated reinforced cement-mortar form
Isometric of prefabricated cement-mortar form

FIG. 2. (left) SEMICUPOLA and its perimetrical ceiling consist of prefabricated cement-mortar units assembled on scaffolding and joined together with cast-in-place concrete. See also photographs above and below. Thrust of semicupola is taken by perimetrical ceiling.

tiple layers of wire netting having a $^3/_8$-in. mesh and a weight ranging between 1 and $1^3/_4$ lb per sq yd. Instead of the usual gravel and sand mixtures, a cement and sand mortar was used, mixed in the proportions of 50 lb of cement per cu ft of sand.

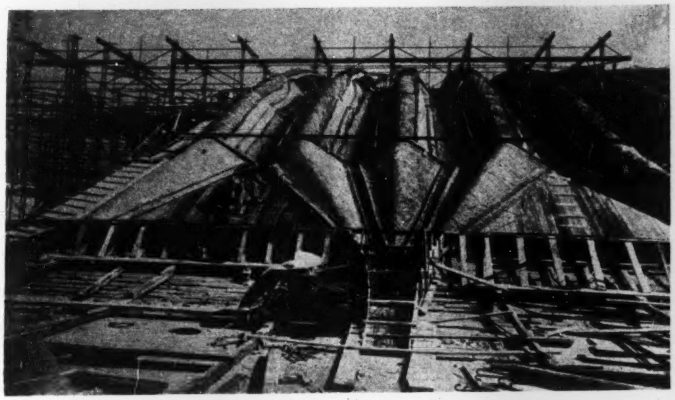
The mortar is applied to the metal frame manually like plaster, to build up the high-strength reinforced cement-mortar structural elements. The principal advantage of this system is that, since the mortar is applied directly onto the netting of the frame, no forms or molds are needed. With such a system it became easy to prefabricate the corrugated-shaped elements, which when assembled, one adjoining the other, and connected with each other and strengthened with cast-in-place reinforced concrete, would form the corrugated arched roof.

This design and construction method provided a good solution to the problem of illuminating Hall B, since a great number of skylights could be placed on the inclined surfaces of the folds. These fundamental considerations and the results of experiments and research, led to the form of the structures shown in the accompanying illustrations.

A particularly intricate problem arose in connecting the corrugated arches with the supporting columns. This structural problem was solved by attaching three folds fanlike to one column as shown in the photographs on the facing page.

Precast Forms Shape Cupola

For building the cupola (Figs. 1(c) and 2), a construction process was used which I had developed a few years ago and which had been successfully applied by Nervi & Bartoli. It consists in setting up the surface to be built with prefabricated elements or large tiles made of cement mortar plastered on



MAIN ARCH RIBS of Hall B (above and right) are supported in threes on columns resting on spread footings. Precast rib elements seen in Fig. 3 below are joined together by cast-in-place reinforced concrete along tops of ribs and in valleys between ribs.

wire netting. These elements, which range in size between 10 and 40, sq ft for easy handling and installing, have their edges shaped to form a network of ribs which, with convenient steel reinforcement and cast-in-place concrete, become the supporting frame for the system.

These cement tiles are $^3/_4$ in. thick and are reinforced with small steel bars and wire netting like that in the precast corrugated reinforced cement-mortar for the arch elements of Hall B, although having lower percentages of steel and wire netting because they do not have an actual load-carrying function. The tiles are precast in cement molds that were precision made to reproduce the exact size and geometrical shape of the surface of the cupola.

When seen from the inside, these smooth and regular cement forms show a precise and regular surface which needs no plastering or finishing of any kind. The geometrical arrangement of the ribs is absolutely free; it is dependent only on statical criteria and esthetic requirements.

Stability Calculations

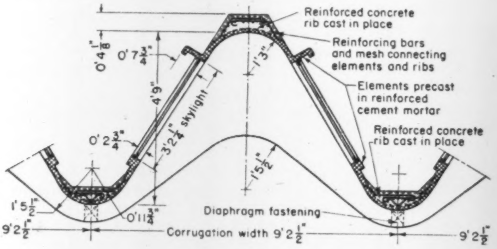
The depth of the corrugations of the Hall B vault increases toward the center for a more efficient arrangement of skylights, Fig. 1 (*b*). The fanlike grouping of the three folds on the top of the large columns produces in the vault a structural behavior similar to that of a two-hinged arch.

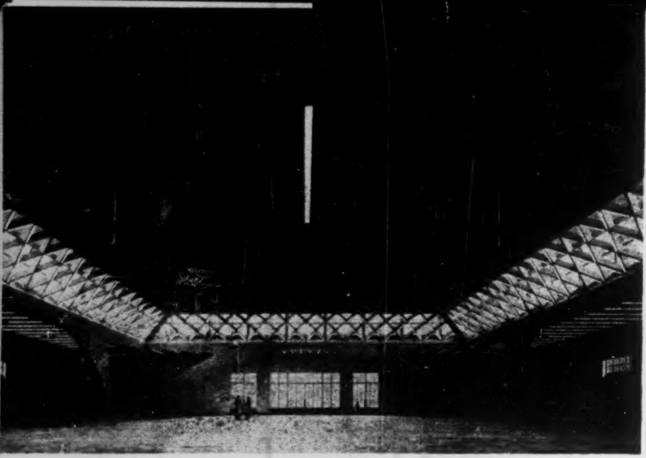
Analytical calculations were based on two separate assumptions—a two-hinged arch and an arch with fixed ends—allowing in each case for the variation of the cross sections, according to the shape established. The two assumptions gave practically the same results.

For stability control, an imaginary arch was assumed having a height and a surface under strain equivalent to those of one fold. Stability calculations assumed 31 psf (lb per sq ft) live load on the whole vault and a temperature variation of ±20 deg C. Maximum compressive stresses resulting in the concrete amounted to 850 psi.

The large columns supporting the vault are shaped to follow closely down to the foundation the resultant of the actual arch reactions and the various dead loads. The pres-

FIG. 3. **PRECAST ARCH ELEMENTS** for Hall B are built up of cement mortar. Mortar, which contains 50 lb of high-strength cement per cu ft of sand, is reinforced with small bars and wire mesh. See also photo below right.


Reinforced concrete rib cast in place
Reinforcing bars and mesh connecting elements and ribs
Elements precast in reinforced cement mortar
Reinforced concrete rib cast in place
0'4 1/8"
0'7 3/4"
4'9"
1'3"
3'2 1/4" skylight
0'2 3/4"
1'5 1/2"
1'5 1/2"
0'11 3/4"
Diaphragm fastening
9'2 1/2"
Corrugation width 9'2 1/2"
9'2 1/2"



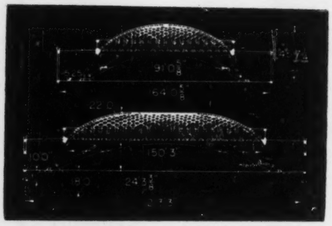
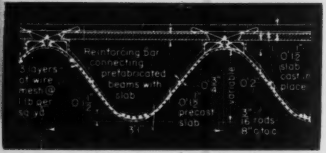


FIG. 5. (above) HALL C ROOF consists of precast units tied together with cast-in-place concrete. Roof rests on inclined arches. See also photo at left, showing pleasing effect of combined prefabricated elements. Neon tubes provide lighting.

VAULT ELEMENTS for Hall C were made during winter in basement of Hall B.



Reinforcing bar connecting prefabricated beams with slab
3 layers of wire mesh @ 1 lb per sq yd
0'1/2"
0'1 1/2" precast slab
0'3/4"
variable
0'2"
0'1 1/2" slab cast in place
3/16" rods 8" c to c
3'1"

FIG. 4. ROOF surrounding pavilion vault of Hall C, called perimetrical ceiling, consists of thin prefabricated corrugated beams and precast slabs. See also photo below.

sure center of the foundation corresponds to the center of the permanent loads. Dimensions of the foundation were so chosen, however, as to keep the unit loads on the ground under 3.5 tons per sq ft, even under the most unfavorable loading conditions. The arch foundations rest on a sand and gravel bank of good load-bearing characteristics.

Semicupola Design

Calculations for the spherical cupola on a semicircular plan with a 131-ft diameter presented a problem that was solved approximately at first, by considering the semicupola as divided into elements by means of sections parallel to the transverse axis of the hall, and by considering the horizontal thrust of each element to be absorbed by the perimetrical ceiling. The 33-ft-wide flat ceiling surrounding the base of the cupola distributes the horizontal thrusts of the semicupola to the retaining walls between Hall B and the cupola. Then the semicupola was considered as a shell and calculated using Prof. F. Dischinger's formulas ("Theory of Design of Non-Symmetrical Vaults and Domes with Non-Symmetrical Loading," *Bauingenieur,* Vol. 16, Aug. 30, 1935, pp. 374–381). The results of the two calculations disagreed much less than had been anticipated, considering the difference between the two theories.

The ceiling over the basement under Hall B was also partly prefabricated. Only the columns and the 33-ft 9-in. main beams were cast in place.

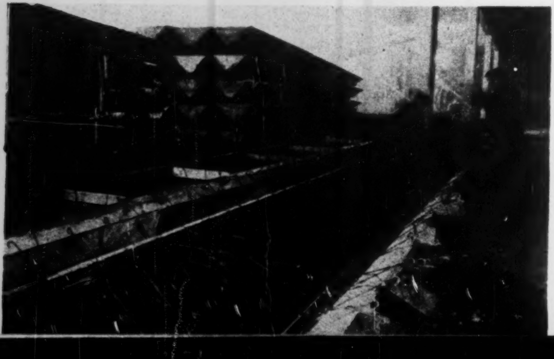
Excavation for the structure and the prefabrication of beams and tiles for the ceiling, corrugated tiles for the vault, and elements for the semicupola, were started at the same time.

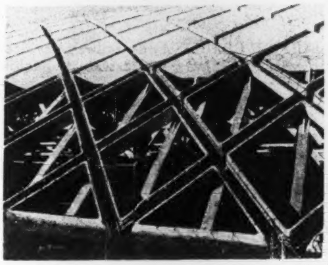
Timber Staging on Pipe Scaffolding

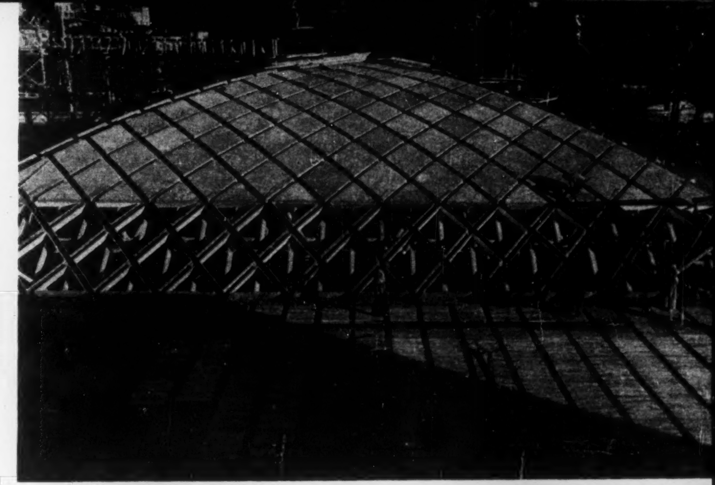
Light timber staging on pipe scaffolding supported the precast elements until they were attached and bonded to each other by reinforcing bars and cast-in-place concrete. Such bonding was provided by the continuous ribs poured within the grooves and on the ridges of the Hall B arch vault folds (Fig. 3); the slab of the ceiling around the semicupola and the ribs and $1^{1}/_{2}$-in. slab of the semicupola itself (Fig. 2); and the ceiling around the pavilion vault of Hall C (Fig. 4).

To secure good bond between the reinforced cement-mortar forms and the cast-in-place concrete, small bars of $^{1}/_{4}$ to $^{5}/_{16}$-in. diameters were left protruding from the prefabricated elements and beams at intervals not exceeding 8 in., while the contact surfaces, which were coated with a thin layer of very rich mortar at the time of casting, were left rough and conveniently scratched. The bond between prefabricated elements and reinforced concrete members cast on the job was perfect.

During the work I feared that differences in the moduli of elasticity of prefabricated concrete parts already seasoned, and of those cast more recently and bonded to them,







CONSTRUCTION VIEWS of Hall C from above show most of precast elements in place, ready for addition of cast-in-place concrete. Under surfaces required no plaster or finishing.

would lead to poor static cooperation, but these fears have proved unjustified. This result proves that concrete has a great capacity for compensating and adjusting owing to its plastic deformability. A deeper knowledge of this property of concrete would be useful for its better utilization.

High-strength cement, in proportions varying from 20 to 30 lb per cu ft of sand, according to the different structural strength requirements, was adopted for all concrete work, both prefabricated and cast in place. The proportions for the reinforced cement-mortar structures was 50 lb of high-strength cement per cu ft of sand. The main vault was erected and completed in four stages, taking less than two months; the semicupola took approximately one week. The scaffolding under the vault was taken down six or seven days after the completion of casting operations, as it was found that the vault was moving upward from the scaffolding because of diurnal temperature variations.

Prof. Ing. Albenga's tests, with loads distributed for the most unfavorable conditions, demonstrated the perfect static behavior of all structures. The semicupola, although having no protective coating of asphalt or any other waterproofing material, has remained impermeable, demonstrating the absence of even capillary leaks.

Hall C Design and Construction

Hall C also presented a difficult problem in design and construction methods because of the short time allowed for the work and because of the time of the year, which was midwinter. A structural and architectural solution using extensive prefabrication of elements was adopted. Fortunately the basement of Hall B was available for precasting operations and they were carried out there, independently of the weather.

Of the various tentative solutions submitted to the management of the Turin Exhibition Center, the one shown in Figs. 4 and 5, consisting of a pavilion vault resting on four large arches, was chosen. The arches rest on inclined planes so as to receive, and distribute to the foundations, the inclined thrust produced by the vault. The inclination of these planes coincides with the resultant of the thrust of the vault, the dead load of the arch, and the reaction of the perimetrical ceiling.

Even if this inclination could be determined with precision, there would still be appreciable displacements due to incidental overloads. A resisting element was thus needed, capable of absorbing any possible excess or deficiency of the system's horizontal component, due to the various overload conditions. This function was entrusted to the large frame composed of the ceilings on the four sides of the hall. These ceilings, as well as those of the semicupola of Hall B, are therefore structurally essential for the general equilibrium of the system.

Prefabricated Ceiling Construction

The ceilings and the pavilion vault are entirely prefabricated. A system of cement tiles similar to that used for the semicupola was adopted for this vault. The ceilings were built with a type of corrugated beam made of reinforced cement-mortar like that adopted for the corrugated vault elements of Hall B.

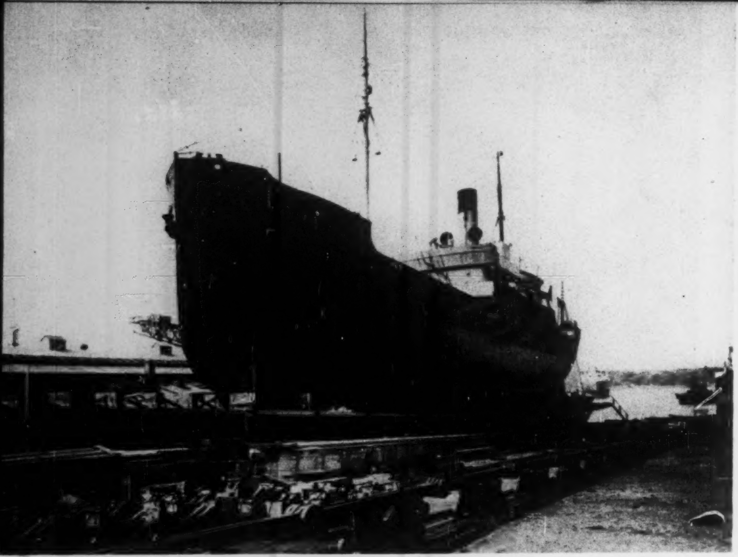
As shown in Fig. 4, this method consists in prefabricating hollow beams, the corrugated sections of which have a sine-wave profile. These beams were assembled in place, one adjoining the other, and then completed with an upper slab cast in place. The finished ceiling thus shows from below a corrguated surface, having good esthetic appearance, while the closed air chamber in each beam provides efficient heat insulation. The beams were cast in cement counter-molds to make their visible surfaces perfectly regular and smooth to avoid the need for plastering.

Three General Conclusions Drawn

Three general conclusions may be drawn from the work here described:

1. Concrete structures have exceptional stability when shaped to provide the supporting functions required. The use of thin shells and spatial structures in general has great possibilities which have only begun to be realized.
2. There are great possibilities for the utilization of prefabrication and of special reinforced mortar forms which become integral parts of the completed structure and eliminate the need for conventional wooden forms.
3. Neither the structural requirements of design nor the practical limitations of construction need ever be obstacles to good architectural expression. This conclusion is the most important of all, in my opinion.

Architectural planning and design of the reinforced concrete structures were done by the writer. The masonry and reinforced concrete work was constructed by the Nervi & Bartoli Construction Co., of which the writer is a partner. Supervision of the work on behalf of the Turin Exhibition Center was entrusted to Ing. Vittorio Bonadè Bottino, with the cooperation of Ing. Luigi Ravelli.



SHIP ON CRADLE of new railway dry dock dwarfs old slipway, which with its hauling gear appears in foreground and to right. Train of 10-ft eyebars is connected to hydraulic piston of equivalent stroke, and four or five hours and forty men are required to raise a vessel out of water by this means. On new dry dock, structural steel cradle runs on moving train of free rollers. (See photo at bottom of facing page.)

J. STUART CRANDALL, M. ASCE

President and Chief Engineer, Crandall Dry Dock Engineers, Inc., Cambridge, Mass.

Railway dry dock in Denmark docks

A VESSEL weighing 2,000 tons can be docked by two men in less than half an hour at the new railway dry dock of Burmeister & Wain in Copenhagen, Denmark. This period is all that is required to get a ship clear of the water and ready for repairs, once it has been grounded on the blocks. A similar period and the same crew of two men is sufficient for undocking.

Larger Vessels Handled Faster

On the old slipway, forty men working for four or five hours were needed to dry dock a vessel of half this tonnage, and nearly the same time and manpower for undocking. In the new dry dock a 2,000-ton vessel can be dry docked, cleaned, painted and floated in one day, whereas formerly two days were required for a 1,000-ton ship.

In 1947, when the new dry dock was started, the shipyard of Burmeister & Wain consisted of modern shipbuilding ways, fabricating shops, two large floating dry docks, a medium-sized basin dry dock and three English-type slipways side by side.

The slipways, of about 1,000-ton capacity, were installed some 70 years ago. The cradles were open framed, three-way structures, supported by truck wheels running on crane-type rails. Above water level, the track consisted of an elaborate arrangement of brick arches and vaults supporting a series of granite blocks under the rails of each way and the paving between the ways, which formed the working floor. The system of arches was supported in turn by brick columns resting on wood piling. The submerged part of the track was of yellow pine, with three longitudinal members under the rails supported by cross caps and wood piling.

Old Slipway Tracks Used for Foundation

Each cradle was hauled by a series of eyebars, 10 ft long, connected to a hydraulic piston with an equivalent stroke. To haul a vessel, the hydraulic piston was pulled up 10 ft, then while the cradle was held on a pawl, an eyebar was removed, the piston returned to its original position, reconnected to the eyebars, and the operation repeated.

Tracks of the old slipways were found to be in remarkably good physical condition, although they showed considerable settlement due to heavy load concentrations under the forefoot, inevitable where the line of keel blocks is parallel to the slope of the ways. Because of the man-hours required for operation, consideration was given to replacement with a more modern and economical type of dry dock, and as a first step it was decided to install a new structure on the site of the middle slipway. The new railway dry dock has the following dimensions, in feet:

	New Unit	Old Unit
Length over keel blocks	240	233
Width over transverse beams	41.7	. . .
Ultimate width over transverse beams	54	. . .
Depth of water over keel blocks at daily water level:		
Forward	7	5
Aft	14	15

Normally a railway dry dock of this capacity would have a two-way track for best economy. However, in view of the excellent condition of the old foundation, which supported a three-way track, it was found advantageous to use three ways on the new dry dock and to support them on the existing structure and foundation except for a short extension at the lower end. Above normal water level, the track was constructed of concrete, each way resting on the original granite slabs. The rest of the track is oak, constructed as a unit ashore and sheathed for protection against marine borers. It was superimposed on the old track structure and carefully adjusted for alignment and grade, then fastened to the original track with drift bolts. Special cement mortar was used between the top of the old track and the bottom of the new one of such thicknesses as necessary to provide a uniform gradient.

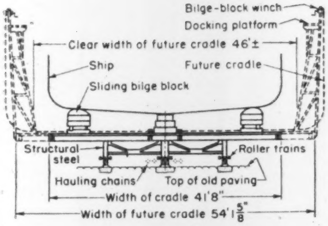
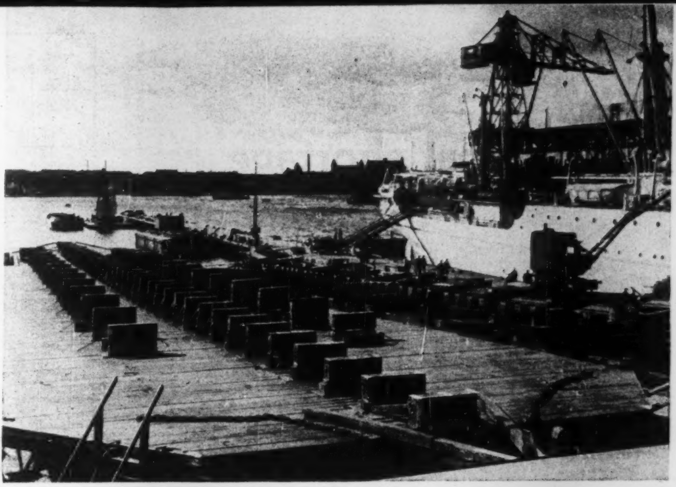


FIG. 1. **NEW DRY DOCK** (above) has three-way track (instead of usual two-way) so as to utilize old slipway foundations, found to be in excellent condition after 70 years. Since new dry dock replaces middle one of three old slipways, space was limited. Cradle will be widened and sides added (see dashed lines) at future date when adjacent slipways are demolished.



NEW CRADLE, of structural steel, carries timber deck for full length to provide convenient working floor. On each side 15 bilge blocks slide along transverse beams. These blocks will eventually be operated by chains and hand winches on docking platforms (Fig. 1).

2,000-ton ship in half an hour

The cradle, of structural steel, consists of a heavy central longitudinal runner and two side runners, corresponding to the track ways, carrying the principal transverse beams (Fig. 1). Because of the existing slipways on each side, it was not possible to make these beams of the full length necessary for the docking platforms, but these beams are to be extended and the docking platforms erected at some later date when the adjacent slipways are removed. The cradle is timber decked for its full length to provide a convenient working floor. On each side there are 15 bilge blocks, sliding along the transverse beams, to be operated eventually by chains and hand winches along the docking platforms, but used in the meantime as fixed blocks.

The cradle moves on free rollers of alloy cast steel, operating between flat steel shoe plates on the bottom of the cradle runners and similar plates on top of the three ways of the track. These rollers are assembled in a train along each way, which moves at half the speed and distance of the cradle. Each train consists of interchangeable sections (frames) of steel angles 15 ft long, with renewable malleable iron bushings, which maintain the rollers at right angles to the axis of movement. This roller system reduces friction to a minimum, eliminates the necessity of maintaining machined surfaces in sea water, and requires no lubrication.

The cradle is hauled by two open-link chains of heat-treated alloy cast steel, which, passing around toothed sprocket wheels on the main shaft of the hauling machine, are connected on an endless system with smaller welded backing chains. The hauling machine consists of a train of steel gears operated by an electric motor of 200 hp which will haul a capacity load in 30 minutes.

The hauling machine, hauling chains, rollers, other castings and lumber were shipped from the United States. Burmeister & Wain fabricated the steel cradle and roller frames.

The railway dry dock, designed by Crandall Dry Dock Engineers, Inc., Cambridge, Mass., was completed and the first vessel dry docked in February 1949, and it has since been in constant use. Messrs. Poul Lorentzen, A. E. Nellemann and K. E. Gudum-Olsen handled the work for Burmeister & Wain, and I. W. Tourtellot, Assoc. M. ASCE, was responsible engineer in charge for Crandall.

CRADLE MOVES on a train of free rollers of alloy cast steel operating between flat steel shoe plates. Each of three roller trains moves at half the speed and distance of the cradle. Two endless open-link hauling chains pass around toothed sprocket wheel on main shaft of hauling machine, operated by 200-hp electric motor.

This critical shortage of engineers

(From Report to EJC's Engineering Manpower Commission, December 18, 1950, by ASEE Representative)

S. C. HOLLISTER, M. ASCE

Dean, College of Engineering, Cornell University, Ithaca, N. Y.

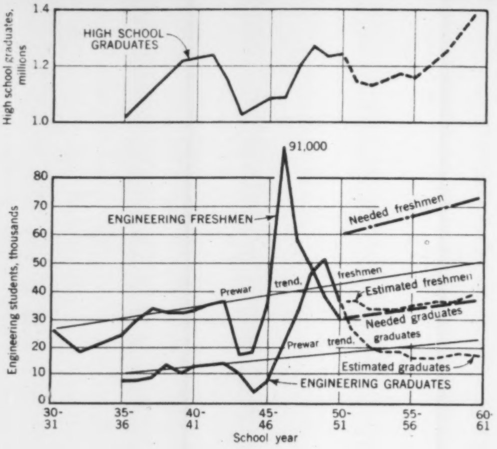


FIG. 1. Veteran program brought unprecedented number of 91,000 freshmen into engineering colleges in 1946, but number has since fallen rapidly, to about half that estimated as essential by Dean Hollister.

OUR COUNTRY is again obliged to arm in an effort to preserve peace, or to repulse attack if it should come. We are greatly outnumbered and our only chance of survival depends upon our ability to out-design, out-develop, out-produce, and out-perform our opponents. In these efforts engineers are essential. But we are short of engineers. The reason is that there has been a falling off in enrollment in the engineering colleges, largely due to the widely held view that engineers are in over-supply. The shortage of engineers will become still more acute if they are called for military service and used in positions for which their training and experience are not mandatory.

The chart, Fig. 1, presents the essential factors in the outlook for the supply of engineering graduates. The lower curve shows that from 1942 through 1945 the country, through its mistaken manpower policy, all but stopped the operation of engineering education. That is why industry today so critically needs engineers with 5 to 10 years of experience.

The dotted line extended beyond 1950 shows the estimated number of graduates if the schools operate without any withdrawals by Selective Service. It represents the most optimistic production possible, at least until 1954, since all classes graduating up to that year are already enrolled.

Beyond 1950, a dotted line indicates the estimated freshman enrollment. This estimate, made before the Korean War, was based on peacetime expectancies. The chief reason why the 1950 enrollment did not reach the estimate is the widespread rumors that the engineering field was oversupplied.

The demand for engineers already shows tightness in all fields, especially in the aeronautical, chemical, electrical, and mechanical fields. Industry has absorbed the last two graduating classes of nearly 50,000 each and is hotly contending for the 30,000 that will graduate in 1951. Many are in ROTC programs and will go direct to military service; others who have draft postponements will be subject to call. On August 3, the Secretary of Labor placed all branches of engineering on the list of critical occupations, and the shortage is becoming progressively more critical.

In normal peacetime it is generally accepted that at least 20,000 engineering graduates are required annually. But after absorbing 50,000 in each of the last two years, industry still does not have all it needs. And the military needs have not yet been assessed. The minimum annual need appears to be not less than 30,000.

The question now is: How can we obtain 30,000 engineering graduates yearly? Since the mortality in the engineering colleges is about 50 percent, an annual input of 60,000 freshmen would be required—about double the number that entered the schools this year. How can twice as many high school graduates be attracted to engineering schools? Since a dip of 10 percent in the numbers graduating from high school is expected between 1950 and 1958, we cannot rely on an increase in the output of the high schools to solve the problem.

Except for the war and immediate postwar years, the numbers entering engineering schools since 1935 range from 2.7 to 3.1 percent of the total high school graduating classes. On the basis of an average high school output of 1,200,000 boys and girls, 5 percent would be required to produce 60,000 engineering freshmen, or about 10 percent of the boys. There is some doubt whether the combined factors of aptitude, ability, interest, and financial means can be found in so high a percentage. This brings home the fact that there is not, and cannot be developed, an inexhaustible supply of engineering talent. The supply will always be sharply limited.

Nevertheless it is essential that all avenues of information be utilized to acquaint high school principals, guidance counselors, and the high school students themselves with the shortage of engineers in all categories.

What is significant to industry in this picture, apart from the fact that young engineers will be in very short supply? Inter-company pirating will only add to the difficulties of staffing, and robbing the colleges of faculty members will dry up the supply and reduce the quality of training. It will be essential for industry to reexamine the functions of engineering personnel and make certain that each engineer is being used in the most effective manner possible. Even competent supporting personnel will be tight. It will be necessary to begin in-service training of supporting personnel and to engage women as far as possible. The training programs of the last war will need to be reestablished. None of these steps can be put off.

Government agencies, including the armed forces, must take cognizance of this situation. Plans must be developed for coordinating the engineering manpower needs of the Services and of industry. To assume that the need for engineers is exclusively military would be national suicide. Sound policies for deferment and the calling of reservists must be promulgated to maintain a balanced utilization.

The technical press reports that the Russians, in their current five-year plan, will have produced 150,000 engineering graduates by the end of 1950. This matches our own output for the same period. During the next five years, however, we will drop by one-third unless drastic action is taken to increase the supply of engineering freshmen and to continue training operations in full force.

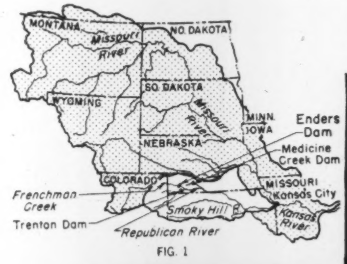


FIG. 1

ROLLED EMBANKMENT of Enders Dam is seen in right foreground of aerial view looking south. Outlet structure and spillway are near center. Relocated Nebraska Highway No. 61 will follow crest of dam. Frenchman Creek flows from right to left.

Enders Dam completed—

U. V. ENGSTROM,
Construction Engineer, U.S. Bureau of Reclamation, Grand Lake, Colo.

Unit of Missouri Basin Project goes into operation

ENDERS DAM, one of the first units of the vast Missouri Basin Project to be started, has recently been completed and is now functioning as a working unit of the Frenchman-Cambridge Division of the project. Designed to provide irrigation, flood control and silt retention, the structure is near the town of Enders on Frenchman Creek in southwestern Nebraska (Fig. 1). It is one of the Division's three major dams in Nebraska. The other two are Medicine Creek Dam, 6 miles north of Cambridge, completed in 1949, and Trenton Dam, currently under construction, the largest of the three, on the Republican River 24 miles west of McCook.

Water from Frenchman and Medicine Creeks will join that of the Republican River to provide for irrigation of the Enders Project, a narrow strip of land 1 to 3 miles wide and 110 miles long. Water will be supplied to 35,500 acres of new land and will supplement the present inadequate supply on another 17,600 acres.

The Bureau of Reclamation began preliminary studies in this area in 1939. From later surveys and studies, made between 1941 and 1943, a report was prepared which formed the nucleus of the plan ultimately prepared for the Frenchman-Cambridge Division. During the years 1944 through 1946, crews of surveyors and engineers obtained detailed field information from which plans and drawings for the construction specifications were prepared, and invitations for bids covering construction of Enders Dam were issued July 30, 1946. Seven bids were received and were opened at the Bureau of Reclamation office in Indianola, Nebr., September 4, 1946. The Wunderlich Contracting Co. of Jefferson City, Mo., submitted the low bid of $4,109,927, and was awarded the contract. Construction of the dam began on January 22, 1947. Later the James & Phelps Construction Co. of Oklahoma City, Okla., entered into a joint venture with the Wunderlich Contracting Co.

Dam of Rolled Earth and Rock Fill

Enders Reservoir is designed for a storage capacity of 74,000 acre-ft. Of this total, 30,000 acre-ft is for flood control, 36,000 acre-ft for irrigation, and the remainder for silt retention. The dam is an earth and rock-fill structure approximately 2,500 ft long, having a height of 103 ft above the stream bed, and containing about 1,300,000 cu yd of fill. A dike 6,420 ft long is located on the north between the dam and the town of Enders. This earth and rock-fill dike has a maximum height of 26 ft and contains 165,000 cu yd.

Relocation of the existing north-south State Highway No. 61, which passes through the reservoir, is completed. The new route begins at Enders, about 2,450 ft north of the dike, and continues over the dike and dam to connect with the existing route about 7,650 ft southwest of the dam. The relocation involves a total distance of 4$^1/_2$ miles.

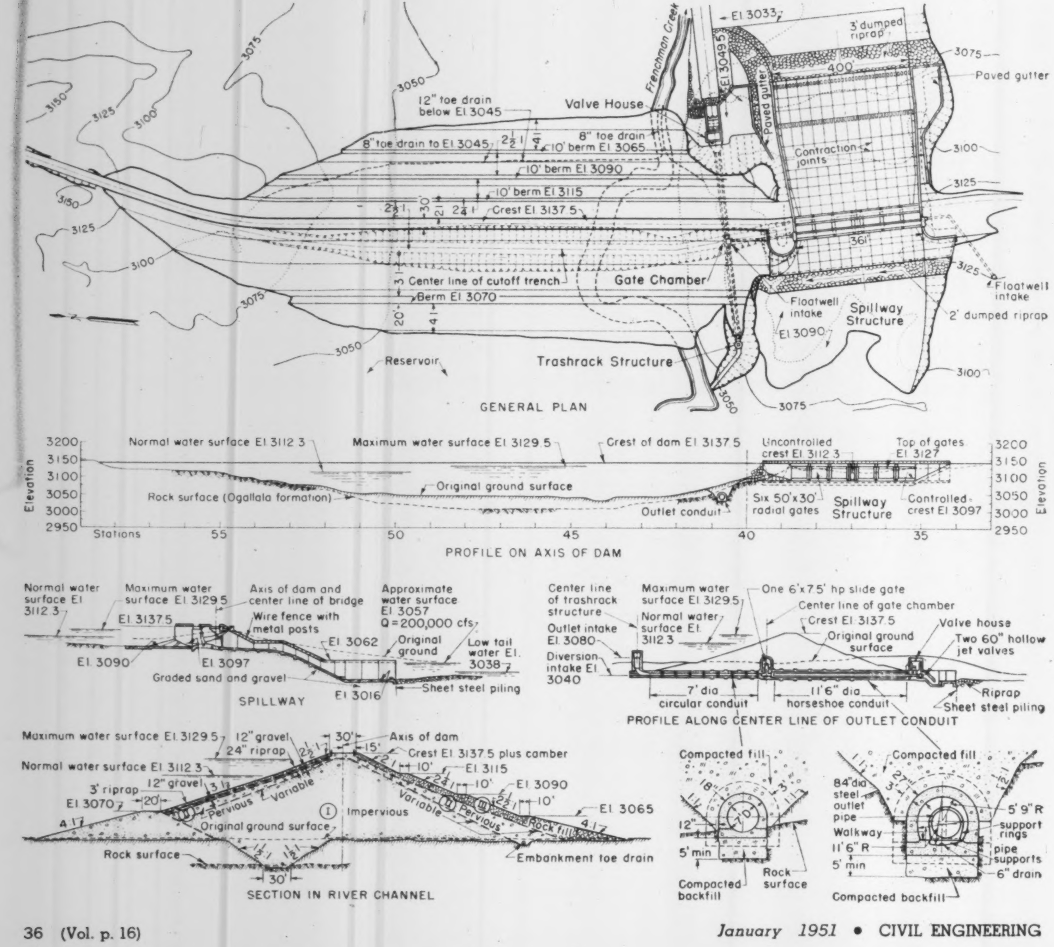
On the right abutment, to the left of the spillway, are the outlet works, which consist of a concrete trashrack structure at the upstream toe of the dam; a circular conduit 7 ft in diameter extending 256 ft from the trashrack to the gate chamber; a 7-ft-dia steel pipe inside a horseshoe conduit 11 ft 6 in. in diameter, extending another 260 ft from the gate chamber to the valve house; and a concrete stilling basin.

The 6×7$^1/_2$-ft emergency slide gate in the gate chamber is controlled at the valve house. A walkway in the horseshoe conduit section provides access to the gate chamber from the valve house. The conduit between the trashrack and gate chamber is a pressure conduit designed to withstand internal and external pressures. In addition to providing access, the horseshoe section is designed to carry the external pressure resulting from the compacted earth fill over it.

The spillway, also on the right abutment, is an open-channel type designed for a maximum capacity of 200,000 cfs and consists of a concrete inlet apron and gate structure at the crest of the dam, a concrete channel, and a concrete stilling basin.

As the dike section was founded on a loess formation of low density and considerable depth, the specifications called for preconsolidation of the foundation by prolonged irrigation.

FIG. 2. ENDERS DAM is earth and rock-fill structure about 2,500 ft long, with maximum height of 103 ft above stream bed, and containing 1,300,000 cu yd of fill. Reservoir will store 74,000 acre-ft for control of floods and irrigation along Republican River

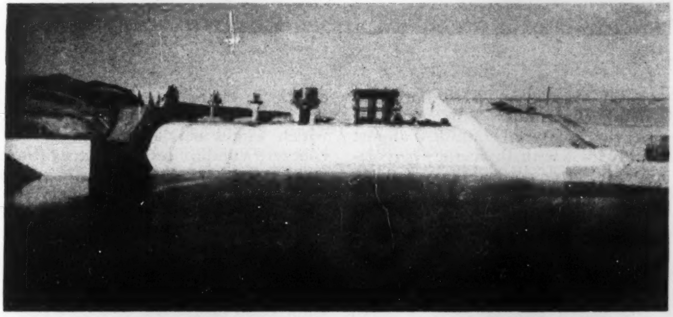

GENERAL PLAN
Frenchman Creek
El. 3033
3' dumped riprap
El. 3049.5
400'
Paved gutter
3075
Contraction joints
3100
3125
361'
Floatwell intake
2' dumped riprap
Spillway Structure
El. 3090
Valve House
12" toe drain below El. 3045
8" toe drain to El. 3045
8" toe drain
10' berm El. 3065
10' berm El. 3090
10' berm El. 3115
Crest El. 3137.5
Center line of cutoff trench
Gate Chamber
Berm El. 3070
Trashrack Structure
Reservoir
3050
3150
PROFILE ON AXIS OF DAM
Normal water surface El. 3112.3
Maximum water surface El. 3129.5
Crest of dam El. 3137.5
Uncontrolled crest El. 3112.3
Top of gates El. 3127
Original ground surface
Rock surface (Ogallala formation)
Outlet conduit
Six 50'x30' radial gates
Controlled crest El. 3097
Elevation
Stations
SPILLWAY
Axis of dam and center line of bridge
Wire fence with metal posts
Approximate water surface El. 3057 Q = 200,000 cfs
El. 3062
Original ground
Low tail water El. 3038
El. 3090
El. 3097
Graded sand and gravel
El. 3016
Sheet steel piling
PROFILE ALONG CENTER LINE OF OUTLET CONDUIT
Center line of trashrack structure
One 6'x7.5' hp slide gate
Center line of gate chamber
Outlet intake El. 3080
Diversion intake El. 3040
7' dia circular conduit
11'6" dia horseshoe conduit
Valve house
Two 60" hollow jet valves
Riprap
SECTION IN RIVER CHANNEL
12" gravel
24" riprap
3' riprap
Axis of dam
Crest El. 3137.5 plus camber
El. 3115
El. 3070
Pervious
Variable
Impervious
Rock fill
El. 3065
Original ground surface
Rock surface
Embankment toe drain
Compacted fill
Compacted backfill
Rock surface
5' min
84" dia steel outlet pipe
Walkway
11'6" R
5'9" R
support rings
pipe supports
6" drain

The contractor began this work first, and all preconsolidation work was completed by the end of June 1947. For this operation, 87,000,000 gal of water were pumped. Placing of the rolled-fill embankment for the dike was started as soon as the foundation became sufficiently dry. Excavation and transportation of construction materials were completed in October 1947. Concurrently with the later stages of dike consolidation, excavation of the dam foundation, outlet works, and spillway was started.

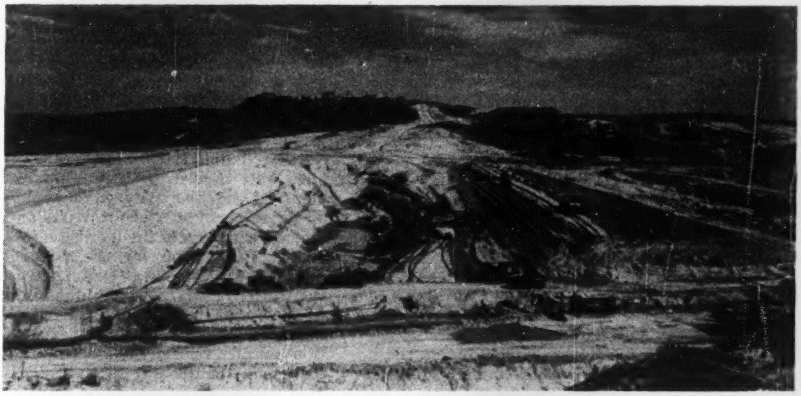
The reservoir and dam sites are in a broad river valley underlain by the Ogallala formation of the Pliocene Age. This formation is overlain by alluvium in the valley floor and by loess and talus on the valley sides. The Ogallala formation is composed of poorly consolidated sediments containing soft chalky sandstones, compact silts, silty sands lightly cemented and uncemented gravels and sands, and various admixtures. Some of the beds are impervious; others are pervious.

A cutoff trench was constructed across the valley floor and extending up each abutment to the top of the embankment. Frenchman Creek was diverted against the right abutment to allow stripping and foundation excavation to proceed while the outlet works were being constructed. The water table was within a few feet of the ground surface throughout the river bottom, necessitating unwatering activities almost from the start. The stripped areas each side of the cutoff trench were dewatered by 2- to 6-in. centrifugal pumps operating out of open sumps.

Dewatering of the cutoff trench was a big problem, but finally the contractor accepted a plan proposed by the Commercial Stang Well Point Co., which was approved by the Government. On the top stage a 6-in. header pipe and 1$^1/_2$-in. well points on 6-ft centers were used. In some areas the well points were jetted into position by the point nozzles; in other areas it was necessary to use 6-in. jet casings. The materials encountered in the excavation were stratified and lenticular, consisting of sands, silts, broken sandstone and siltstone layers. The character of the material was not ideal for a well-point system, and at times it was necessary to resort to open sumps and auxiliary pumps, particularly where the excavation cut into water perched on underlying impervious strata.



SPILLWAY is designed to pass 200,000 cfs through six radial gates. Flow discharges into stilling pool in foreground. State Highway No. 61 passes over dam and spillway.

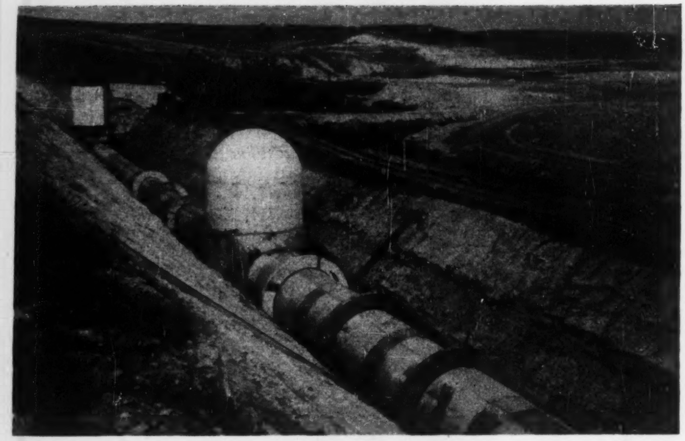


CUTOFF TRENCH excavated 43 ft below river bottom, is unwatered by two stages of well points and by sump pumps. It was later backfilled with impervious material.

TABLE I. DATA ON ENDERS DAM, NEBRASKA

Place	350 miles west of Kansas City, Mo.	**Spillway**	Open-channel type for 200,000 cfs
Purpose	Flood control and irrigation of 53,000 acres	**Crest control**	Six 50×50-ft radial gates
Type	Rolled earth and rock fill	**Outlet works**	7-ft-dia outlet conduit of 1,300-cfs capacity
Begun	Jan. 1947, completed Jan. 1951	**Contractor**	Wunderlich Contracting Co. and James & Phelps Construction Co.
Height	103 ft, length 2,500 ft	**Contract amount**	\$4,109,927
Volume	1,300,000 cu yd of fill	**Material and equipment furnished by Government**	\$838,000 (estimated)
Concrete	45,000 cu yd		
Reservoir	74,000 acre-ft		

OUTLET STRUCTURE consists of conduit 7 ft in diameter. Intake trashrack structure in distance is connected with gate-valve chamber (domed structure) by 265 ft of 7-ft-dia concrete conduit. Horseshoe section of 11½-ft diameter in foreground houses 7-ft-dia steel pipe which terminates in two 5-ft hollow-jet valves. Collars cut seepage along conduit.



On the bottom stage, the well points were set on 4-ft centers. When excavation reached the required depth, the considerable amount of water which leaked past the well points along the contact between the river sands and the Ogallala formation, was pumped out from sumps. A system of gravel-covered tile drains, constructed parallel to the center line of the trench and at the toe of the excavation, led the seepage to the sumps. Discharge from the entire system, well points and sumps, was approximately 5.5 cfs when the excavation reached the maximum depth of 42 ft below the original ground surface.

During excavation of the cutoff trench, excavation from the outlet works was placed and compacted in the upstream cofferdam, which formed a part of the upstream toe of the dam, and also in the rock fill on the downstream side. Placing of impervious embankment in the cutoff trench was started in October 1947, and the embankment was well above the original ground elevation by the time placing was suspended because of cold weather in December. The following season, excavation of the small remaining part of the cutoff trench on the right abutment was completed and the embankment fill for the entire dam was placed to an elevation 14 ft below the crest of the dam. Freezing weather again forced a shutdown of earthwork operations in November 1948. Work on the embankment proceeded intermittently during 1949, and by October the earthwork was completed.

As shown in Fig. 2, the design of the 103-ft-high dam embankment requires three types of material: Zone I, impervious; Zone II, upstream and downstream of Zone I, pervious; and Zone III, rock fill. Zone I and II materials were placed in 6-in. compacted layers. Zone III material was placed in 3-ft uncompacted layers.

Materials not available from the required excavation were borrowed from adjacent areas. Borrow pits for impervious material contained almost entirely loess with an average percolation rate, after compaction, of 0.359 ft per year and an average compacted dry density of 111 lb per cu ft. The pervious material consisted of alluvial river sands or sands found in the Ogallala formation. Particle size varied from $^3/_4$ in. down to fine sand with a compacted dry density of 120.3 lb per cu ft, and an average percolation rate of 677 ft per year. Pervious material was very scarce and the pervious zones in the dam were made as small as possible consistent with sound design practice.

Almost all the rock fill was obtained from excavation for the structures. The material placed in this section was not as clean and durable as that usually found in rock fills, but was the best available in the area and forms a suitable protective cover for the downstream dam embankment.

Riprap Protects Upstream Face

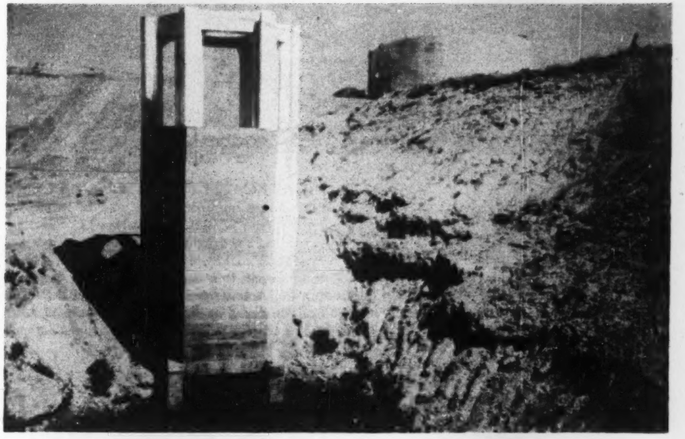
A 12-in. layer of gravel under a 3-ft layer of rock riprap protects the upstream face of the dam. The thickness of the riprap for the flood storage pool at the top reaches of the dam is 2 ft. Rock for riprap was shipped by rail from Guernsey, Wyo. The gravel blanket was obtained by crushing the most durable native rock available in the area.

Excavation for the outlet works totaled 114,000 cu yd; that part occupied by the trashrack and conduit was completed in August 1947. Excavation was entirely in the Ogallala formation and the material was very erratic in characteristics. To avoid the possibility of unequal settlement, which would be detrimental to the concrete conduit section, excavation was carried 5 ft below grade and backfilled with compacted impervious materials. This excavation and refill operation and the foundation for the conduit sections were completed in September 1947. Excavation for the valve house and stilling basin continued and progressed to such a point that the first concrete could be placed in December.

Spillway and Stilling Basin Excavated

Excavation for the spillway totaled 820,000 cu yd, a large part of which was in the Ogallala formation. The excavated materials, whenever suitable, were used in the dam embankment. Otherwise they were wasted on or adjacent to the upstream and downstream toes of the dam embankment. Excavation for the channel and gate structure was completed in the winter of 1947–1948, and excavation of the stilling pool started in March 1948. Stilling-basin excavation required considerable dewatering equipment in the way of well points and sumps. The maximum amount of water pumped from this area was 5 cfs. Grade was reached throughout the basin area by the end of August 1948.

Before the spillway stilling basin was excavated, a drilling program was carried out to investigate foundation characteristics. About 24 borings were made in March and April of 1948. Samples were taken and field pumping tests and field penetration tests carried out, as well as laboratory studies.



TRASHRACK STRUCTURE at intake of outlet conduit is here seen ready to receive gratings in openings at top. Maximum capacity is 1,300 cfs.

Three general types of materials were found in the foundation—highly cemented sands, permeable uncemented sands, and impermeable silts and silty sand with varying degrees of cementation. The permeable sand was the only material of questionable character. Results of the drilling tests indicated that for the most part these sands were sufficiently compact to support the structure.

Tests taken in the foundation, after excavation was completed, showed these sands to have an average relative density of 86.2 percent. In a small area at the downstream edge of the pool, some river-deposit sands of very low relative density were encountered. These sands were removed and replaced with compacted select sand.

A steel sheetpile cutoff was driven into the Ogallala formation to a maximum depth of 30 ft under the downstream pool cutoff and adjacent to and outside of the pool wall footings.

Aggregate Trucked 70 Miles

Under contract specifications, Republican River sand and aggregate could not be used in the concrete for Enders Dam. The contractor made arrangements with a producer having a plant 70 miles away, on the South Platte River near Ogallala, Nebr. The gravel from this location was predominately feldspars and quartz, with smaller proportions of rhyolites, porphyries, andesites, and cherts. The sand consisted of similar minerals containing some opal and acid glass.

The two aggregate sizes required were $^1/_4$ to $^3/_4$ in. and $^3/_4$ to $1^1/_2$ in. When the supplier found it difficult to furnish adequate amounts of the $1^1/_2$-in. size, supplementary materials in this size were shipped from Golden, Colo., and Guernsey, Wyo.

Materials were transported by truck and unloaded at the dam site into frame storage bunkers built on a side hill. The contractor elected to dry batch the concrete ingredients at a separate batching plant and to truck the dry batches to the two paving mixers.

The batching plant consisted of three 100-cu yd bins and one 300-bbl cement silo. Aggregates were released from the side-hill bunkers on to an elevated conveyor belt for transportation to the batching bins. A four-beam scale was used to weigh the aggregates, and a dial spring scale to weigh the cement. Because of excessive amounts of under-size material in the aggregates, a double-deck vibrating screen was installed above the batch bins in April 1948. This installation had two 3×8-ft screens, the upper screen with $^7/_8$-in. openings and the lower with $^3/_{16}$-in. This arrangement completely eliminated troublesome work stoppages caused by improper grading.

Small trucks capable of hauling two batches were used to transport the dry batches to the mixer. An air-entraining agent was introduced with the water through automatic dispensers. The concrete was moved from the mixer to the forms by a crane and a $1^1/_3$-cu yd bucket or by a pumping machine.

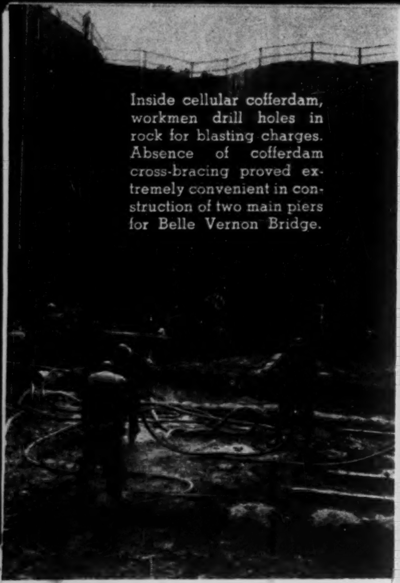
The first concrete for Enders Dam was placed in the invert of the circular conduit of the outlet works early in September 1947. Work on this structure was pushed so that the river could be diverted through the outlet works and the dam cutoff trench completed. In both the horseshoe-shaped conduit and the circular conduit, the inverts were placed first and without inside forms. The remainder of the conduits were formed using prefabricated steel shapes. Specifications required that on both conduits the concrete be placed in 28-ft sections leaving a 4-ft gap between the sections. The 4-ft closures were placed after the adjacent sections were 10 days old. This work was coordinated with the placing of concrete in the trashrack, gate chamber, valve house, and stilling pool.

The work was sufficiently advanced to permit installation of the steel pipe in the horseshoe conduit in May 1948, which was completed on the first of June. On June 6, the river was diverted through the outlet works. Concrete work on the superstructure of the trashrack, gate chamber, and valve house was carried on intermittently thereafter, and the last concrete was placed in the spring of 1949. There were 4,743 cu yd placed in the outlet structure.

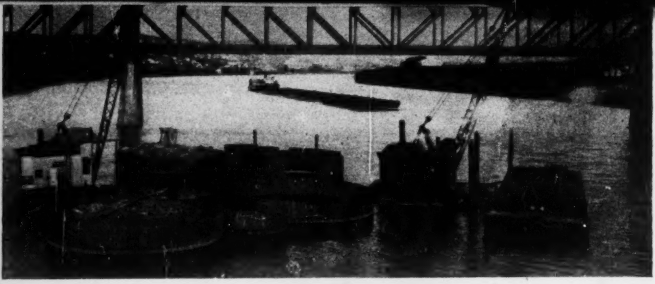
Concreting of the spillway, totaling 40,348 cu yd, was started on the inlet forebay in April 1948, and by the end of the year 24,330 cu yd had been placed. There remained the bridge and piers of the gate structure, parts of the left and right channel walls, parts of the stilling pool, and a section of the floor. Then came a three-month period of severe winter weather during which dewatering of the spillway pool was continued but no concrete was poured. When work was resumed, efforts were concentrated on completion of the stilling pool and gate structure, using other concrete work as fill-ins. As of December 17, 1950, all the concrete has been placed, gates installed, and 6,570 acre-ft of water stored behind the dam.

Enders Dam was designed and constructed by the Bureau of Reclamation under the direction of L. N. McClellan, M. ASCE, Chief Engineer. The writer was Construction Engineer.

The Frenchman-Cambridge Division is located in Region 7, of which A. A. Batson is Regional Director. H. E Robinson is District Manager. Guy H. James, Assoc. M. ASCE, is Project Manager for the contractors. R. E. Leech is General Superintendent.



Inside cellular cofferdam, workmen drill holes in rock for blasting charges. Absence of cofferdam cross-bracing proved extremely convenient in construction of two main piers for Belle Vernon Bridge.



FLOATING RIGS drive M-112 steel sheeting in cellular cofferdams for one of two main river piers. Although this type of cofferdam is seldom used for single river piers, ease of operation inside, and depth of pier justified their use in this case. One small connecting cell was driven 3 ft lower than the other cells to serve as flood gate in case of high water in Monongahela River.

R. B. HOWARD

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Single bridge piers built

ADVANTAGES of the cellular cofferdam technique were effectively demonstrated in the construction of bridge piers for the Belle Vernon Bridge, recently completed for the Pennsylvania Department of Highways by the Dravo Corporation. The bridge substructure consists of eleven piers and two abutments. When completed, the bridge will carry a four-lane highway across the Monongahela River between Speers and Belle Vernon, Pa., 25 miles southeast of Pittsburgh. The project is part of a long-range program to connect the Pennsylvania Turnpike with Ohio, bypassing Pittsburgh.

Steel sheetpile cellular cofferdams were constructed for the two main river piers, and single-skin cofferdams with internal bracing for the two piers in shallow water near the river banks. The chief factor in the decision to use the more expensive cellular cofferdams for the main piers was the 50-ft depth from pool stage to rock, and the additional 25-ft excavation into rock for the pier footings, a total depth of 75 ft below pool stage.

Cellular cofferdams are considerably more expensive and hence are seldom used for the construction of a single pier. In this particular case the extra expense was justified for several reasons. Besides meeting the requirements of extra depth, the cellular type eliminated the need for placing, and later removing, bracing sets as the pier construction moved upward. Construction joints were placed as desired, since the area inside the cofferdam was always open, providing free access to any part. Cross bracing and jutting pieces of timber and steel, which are safety hazards, were avoided. Not one lost-time accident occurred during the placing and removal of the cofferdams for the two main piers, or during the construction of these piers. Also the tops of the cells were useful for storing construction materials.

Each of the two main-pier cofferdams consisted of six 52-ft-dia cells and six smaller connecting cells. For Pier 5, all these cells were filled with sand and gravel dredged from the river bottom, and the cofferdam was pumped dry. A whirler crane mounted on the cofferdam had free access to the entire area. One of the small connecting cells was cut off 3 ft lower than the others to serve as a flood gate in case of high water.

The river bed was always predredged before driving steel piling for the circular cells, to remove any boulders or other debris. For the large cells, after pre-dredging, a circular wood template was floated in, set in correct position by triangulation from the river bank, and spudded down with four 50-ft 53-lb H-beams. The sheetpiling was then set and driven. When the cell was completed, the template was removed and floated into position for the next large cell. Meanwhile, the completed cell was filled with sand and gravel dredged from the river bed. When the six large cells around one pier were driven and filled, the six smaller, connecting cells were driven. Each main-pier cofferdam required 1,000 pieces of M-112 sheetpiling.

The completed cofferdam was capped with about 6 in. of concrete to keep flood waters from scouring out the fill. Drainage holes were provided on the inside face of the cell to keep the fill as dry as possible, thus lowering the hydrostatic head and reducing interlock stresses on the piling.

Shortly after the cofferdam was pumped dry, air compressors and receivers were set up, and the line drilling around the perimeter of the footers was completed. Dynamite holes were then drilled, loaded, and shot and the loose rock was mucked out. This operation was repeated until a depth of 25 ft below the rock surface was reached.

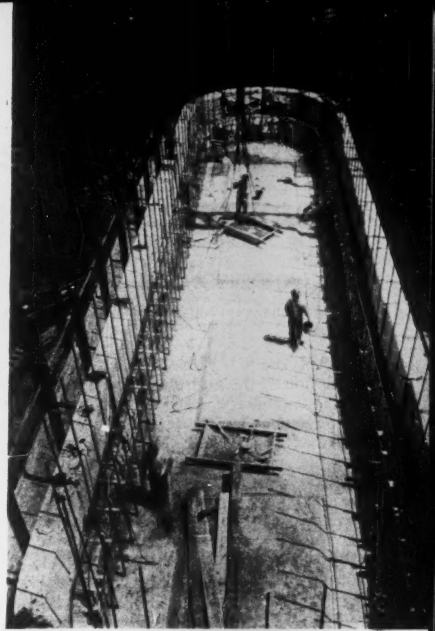
All rock excavation came no nearer than 6 ft to the cofferdam wall. The rock showed no sign of cracking or sliding during excavation, but bracing was used as a safety precaution. Pressure grouting was used to stop the flow of water encountered 13 ft below the top of the rock.

This rock excavation was needed for the two pedestals which support the 8-ft-thick footing slab. After the pedestals were poured to a height of about 20 ft above rock, backfill was placed around them and the footing slab was poured. The pier was faced with stone from the footing slab to a height of about 30 ft. Stone laying progressed at a rapid pace as no internal bracing had to be removed from the cofferdam. Above the masonry facing, Piers 5 and 6 consisted of two separate shafts each.

When the working level was above waterline, the cofferdam cells were

CONCRETE is poured in excavations for pedestals, which were raised to height of about 20 ft above bedrock. After backfilling cofferdam, 8-ft-thick footing slab was poured on pedestals to support pier. Pedestals extend 25 ft below surface of rock.

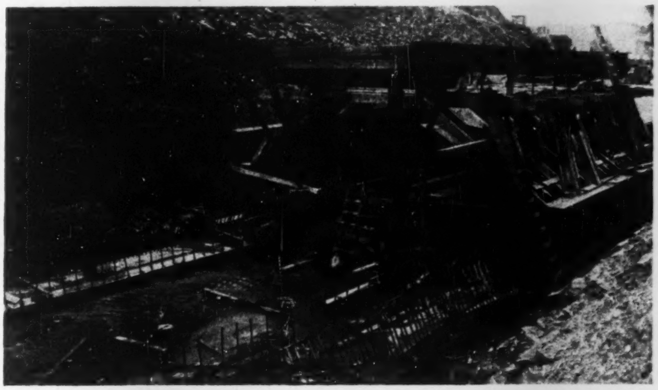
in cellular cofferdams



PIER (above) is faced with stone for height of about 30 ft above footing slab. Stone laying progressed rapidly, unhampered by internal cofferdam bracing.

hogged out and the piling was pulled. It took about one month to place a cofferdam, but only half that time to pull it. The eleven piers and two abutments required approximately 13,000 cu yd of concrete.

REINFORCED CONCRETE CULVERT (below) is constructed to carry waters of small creek under approach fill. Traveling arch forms roll forward on tracks on previously poured invert. Back end of outer form rests on concrete of previous pour.



Culvert Diverts Creek

The building of two reinforced concrete arch culverts was also included in the substructure contract. These culverts have a clear channel width of 20 ft, and carry the waters of a small creek beneath the fill for the approaches at the east end of the bridge. One culvert is 869 ft long, founded on clay and shale. The other is 212 ft long and is built on concrete bearing piles extending to rock. Both arches required about 10,000 cu yd of concrete. About 50,000 cu yd of earth had to be excavated to build the arches.

The longer arch culvert was poured in 25 monoliths, and consisted of 50 pours—25 for the invert and 25 for the arch. Monoliths 12 through 25 were on a long-radius curve, but the same forms were used as on the other monoliths. Invert forms were kept well ahead of the arch forms. The shorter arch consisted of only 7 monoliths, and was poured after the long arch was completed, using the same forms.

The outside arch forms, of timber construction, were hung from a steel carriage with the front end riding on rails placed on the invert concrete. The rear end of the carriage was carried by a small dolly traveling on top of the arch concrete. By using this method, the form could be jacked up and moved to the next position after each pour.

The inside timber form was carried on a steel carriage which traveled on the same rails as the outside form carriage. After the outside form was moved to a new position, the inside form was winched ahead into its new position under the outside form. Reinforcing steel was wired in position, a bulkhead was placed between the two forms, and they were then ready for pouring. The foregoing process was repeated 25 times to pour the arch of the 869-ft culvert.

The creek was diverted during construction and then rediverted to flow through the culverts so that the necessary earth fill for the east abutment could be placed.

All concrete for piers and arches was mixed in a floating plant. Concrete for the land piers and arches was passed to trucks on the river bank. The entire job was completed in about eleven months. The contract price for the work here described was $2,087,308.

Charts determine concrete pavement design for airports

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CHANGES IN DESIGN and construction of the aircraft of today have made necessary new developments in pavement for airports. Mammoth bombers with a 350,000-lb gross weight, jet fighters with tire pressures of 250 psi, new types of multiple-wheel landing gear, jet fuels and exhaust temperatures on the pavement up to 1,200 deg F, are just a few of the new problems confronting engineers responsible for airport pavements. Necessary changes in design, construction and maintenance to meet these problems have all been made in the past five years. Just one phase of these new developments—the *design* of concrete airport pavements—is considered here.

In "Influence Charts for Concrete Pavements" (*ASCE Proceedings Separate* No. 12), Gerald Pickett and G. K. Ray present a series of charts for the design of airport pavements. Based on their influence chart No. 2 (page 16), the writer has developed practical design charts for planes employing each of the three types of landing gear now commonly used (Figs. 1, 2 and 3). These three simplified design charts will greatly expedite the work of the busy airport pavement designer. In each chart E = 4,000,000 psi and μ = 0.15.

The design chart, Fig. 1, is for the case of planes with single-wheel landing gear and is subdivided on the basis of the load carried by each wheel. Wheel loads represent the range from 15,000 to 100,000 lb given as standard by the Civil Aeronautics Authority.

For each wheel load, the solid heavy diagonal line represents an average tire pressure. The broken lines on each side of the average give the range of tire pressures usually encountered for each load. The curved lines represent various values of k, the modulus of subgrade reaction. Intermediate values of k, wheel load or tire pressure can be interpolated. The values on the left and right ordinates of the chart give stress and thickness of the pavement respectively.

When determining the thickness of concrete pavement it is necessary to determine the allowable working stress of the concrete to be used. This is done by dividing the obtaining modulus of rupture of the concrete by an appropriate safety factor. In the design of aprons, taxiways and runway ends, where loads are standing still or moving slowly and where the traffic is channelized to cause a high frequency of loading, a safety factor of 1.8 to 2.0 is used. On the central portions of runways, where loads are moving rapidly and are partly airborne, and where traffic is more evenly distributed over a wider pavement, the frequency and magnitude of stresses are lower and a safety factor of 1.3 to 1.5 is used. The safety factors to be used will depend on the frequency of the

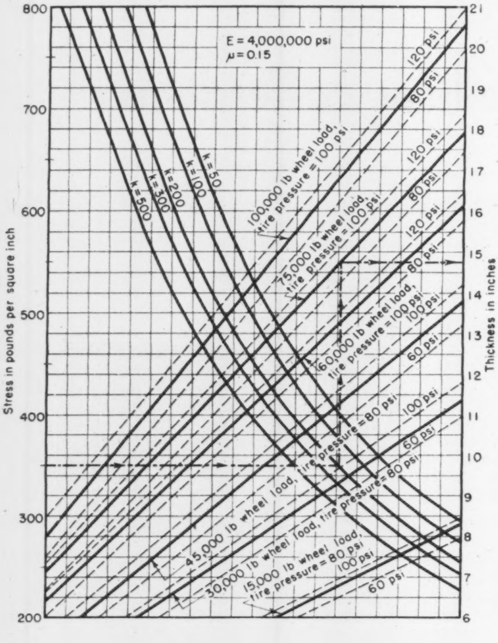
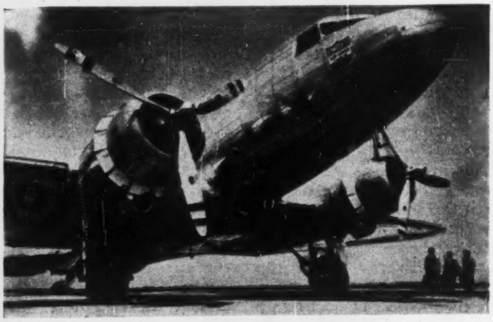


FIG. 1. CHART simplifies design of concrete pavement to serve planes with single-wheel landing gear, as shown below.



actual or anticipated controlling wheel loads.

The dashed line with the superimposed arrows illustrates the method of using the chart to determine the slab thickness required for a given set of conditions. Concrete having a modulus of rupture of 700 psi, a subgrade having a *k* value of 200, a plane having a wheel load of 75,000 lb, and a service condition (apron or taxiway) requiring a safety factor of 2, were assumed for illustration. Procedure for using the chart is as follows: Starting with a working stress of 350 psi (700 divided by 2) at left ordinate, proceed right and horizontally to the intersection of the curved line for the *k* value (here 200); trace vertically from this point to the intersection of the wheel load in question (75,000 lb); thence horizontally to the right-hand ordinate, where the required thickness of $14^3/_4$ in. is read.

The design chart can also be used in reverse to determine the stress in a given slab thickness under a known load.

Another type of landing gear in common use on some planes has dual wheels. An example is the Lockheed Constellation with three sets of dual wheels to carry a total load of 107,000 lb. The chart prepared for this type of landing gear is shown as Fig. 2.

Some of the heavier planes in use today have what is designated as a dual-tandem landing gear, for which the chart, Fig. 3, has been prepared. The method of using Figs. 2 and 3 is the same as that which has been described for Fig. 1.

(*The paper on which this article is based was originally presented before the Air Transport Division at the ASCE Meeting in Los Angeles.*)

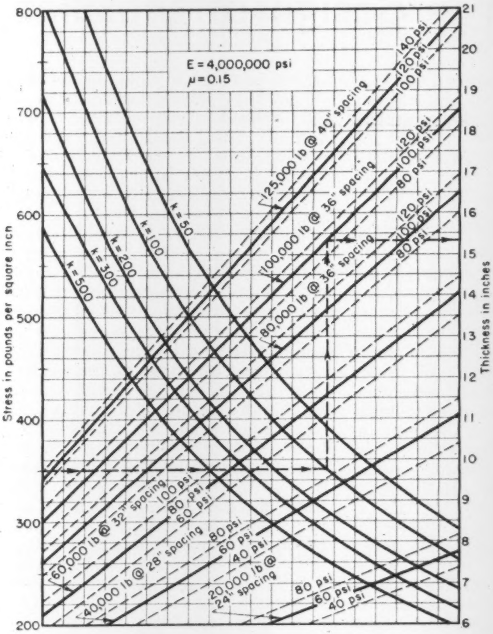


FIG. 2. CHART simplifies design of concrete pavement to serve planes with dual-wheel landing gear, as illustrated below.

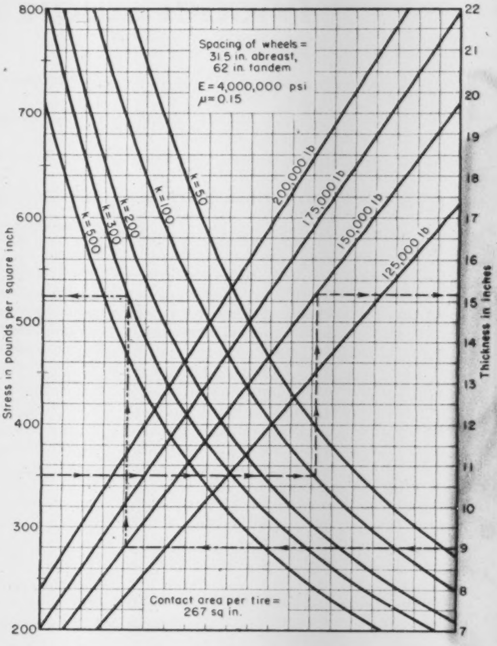
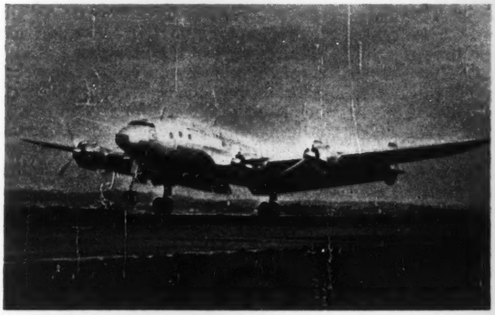
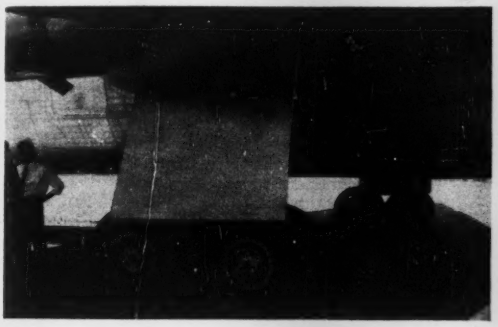
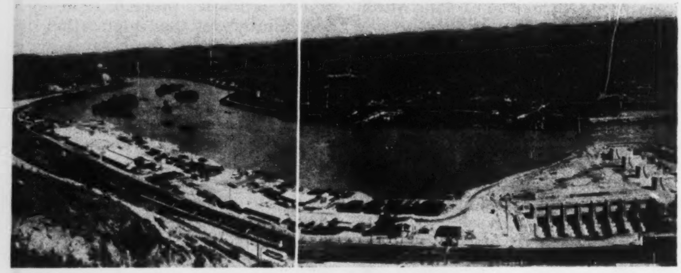


FIG. 3. CHART simplifies design of concrete pavement to serve planes with dual-tandem landing gear, as illustrated below.







DIVERSION up to maximum of 5,000 cfs from Paraiba River will create power for use in Rio de Janeiro, Brazil. Piers for Tainter gates of Santa Cecilia Dam appear at far right, just above pumphouse structure under construction in right foreground.

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Model studies aid in design of Brazilian

HYDROELECTRIC DEVELOPMENT is facilitated in the region between Rio de Janeiro and Sao Paulo, Brazil, by an unusual drainage pattern. A high plateau rises in a sharp escarpment near the coast. Most of the rivers of this plateau either flow far into the interior or fall swiftly to the coastal plain, but the Rio Paraiba (Fig. 1) runs parallel to the crest of the escarpment and the coastline a thousand feet or more above sea level. Thus, discharge and head, the two requisites for power, are potentially at hand.

The Rio de Janeiro Tramway, Light and Power Company is changing this power potentiality to actuality by diverting flow from the Paraiba over the escarpment. By pumping a height of 160 ft, a subsequent fall of 1,000 ft is realized. The total diversion will eventually be over 5,000 cfs. Construction by contract was begun in 1947 and completion is expected by 1951, at a total cost of $50,000,000.

The diversion includes several subprojects (Fig. 1). On the Paraiba River a shallow pool is to be created by the Santa Cecilia Dam. From this pool a set of pumps will lift part of the flow to the Sant'Ana Reservoir on the Pirai River by way of the Santa Cecilia Tunnel and Canal. At the head of this reservoir a second set of pumps will lift the water to the Vigario Reservoir. The diversion will then be completed by gravity flow through the Vigario Canal and Tunnel to the Forcacava Power Plant.

Several knotty problems arising in the design of the project have been investigated through model studies by the Iowa Institute of Hydraulic Research. The most interesting of these are the diversion of bed-load sediment from the Santa Cecilia pumps and the improvement of the transition structures of the Santa Cecilia Canal. Studies conducted for the calibration of the Tainter gates of the Santa Cecilia and Sant'Ana Dams and the design of spillway appurtenances of the Sant'Ana Dam were of a more routine but nonetheless interesting nature.

Bed-Load Movement Studied by Model

Since improvements upstream on the Paraiba could not be flooded, the Santa Cecilia Dam was designed as a movable barrage of Tainter gates seating level with the river bed. During low-water periods a pool 20 ft in depth may be maintained for pumping, but during the flood season the gates may be opened above high-water level. Because various economic factors required the pump house to be placed directly on the bank of the river, it became necessary to devise a structure which would exclude bed sediment from the pumps without producing appreciable backwater at flood stage. The clearances of the pumps selected would allow the passage of silts and fine sand, so that complete protection was not imperative. However, sampling of the bed-load during moderate flow revealed the movement of sand and gravel up to 4 in. in diameter, and it is apparent that material of such size would constitute a considerable maintenance problem.

For the purpose of investigating the natural flow conditions, a 1:75 undistorted scale model of the section shown in Fig. 2 was constructed in the Institute laboratory. The fixed-bed type of model was adopted, since bedrock was exposed in the region of the dam site. The conventional Froude criterion for the model-prototype discharge ratio, usually satisfied by artificially roughening the model, was not followed. Instead, the model was forced to duplicate known stage-discharge relations by varying the tailgate setting and the model discharge, the operating curve shown in Fig. 3 thereby being obtained. The deviation from the Froude criterion is the result of viscous influences, which are appreciable in the model but almost non-existent in the actual river.

With the model discharges established, the patterns of flow and of sediment movement in the unimproved model were investigated for five stages ranging from 9,000 to 70,000 cfs. Time-exposure photographs of confetti yielded both magnitude and direction of the surface velocities. Direction and relative magnitude of the bottom currents were determined by observing and timing the movement of pulverized coke on the model bed. The course of coke particles introduced at the head of the model indicated the principal sediment channels. Correlation of the patterns of flow and of sediment movement then permitted delineation of the probable areas of deposition and scour.

Most pertinent to the problem was the pattern of sediment movement. Two main sediment channels were apparent, the major portion passing on each side and a lesser amount finding its way through the group of islands (Fig. 2). As it approached the rock ridge, the right-hand channel divided, part of the sediment passing through the discontinuity between the ridge and the right bank and part being deflected to the left into the other channel; the left-hand channel was simply deflected farther to the left. The material moving parallel to the ridge either passed through the discontinuity near the left bank or passed over the ridge, roughly normal to the axis. Areas of probable deposition were all upstream from the slanting ridge, whereas the bed-rock area in front of the pump

hydro project

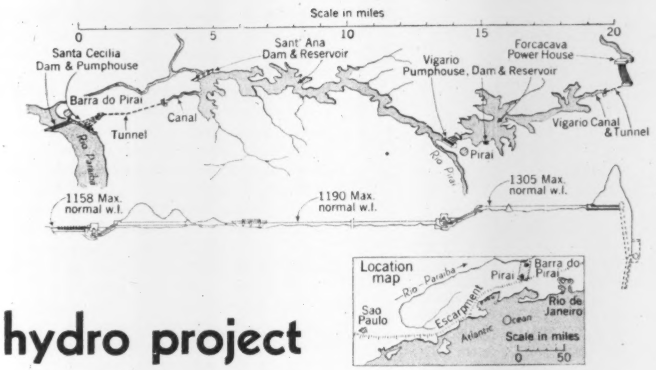


FIG. 1. **LOCATION of Paraiba River on high plateau, with steep escarpment near sea coast, makes possible diversion through escarpment to develop power at sea level. Chief structures in project are shown on detailed map at left and profile aligned with it below. Diversion structures on Paraiba River itself are shown in Fig. 2 below.**

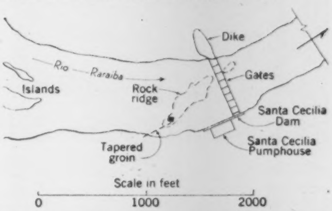


FIG. 2. **DIVERSION STRUCTURES on Paraiba River consist of Santa Cecilia Dam and Pumphouse. Dam is movable barrage of Tainter gates seated level with river bed to avoid flooding of upstream improvements.**

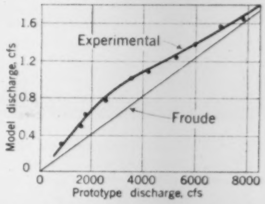


FIG. 3. **MODEL STUDY of section of river shown in Fig. 2, above, yielded experimental curve which differed from Froude criterion. Deviation is believed to be result of viscous influences appreciable in model but almost completely absent in river.**

intakes appeared likely to be swept clean. Qualitative descriptions from the field confirmed the model observations of both the flow and the sediment movement.

Scale models of the dam and the pumping plant were then introduced. The structures themselves were found to have little effect on the flow pattern, except for moderate backwater and local contraction at the dam. A material reduction in velocity, of course, resulted from the formation of a pool behind the dam. Moreover, the flow pattern in the vicinity of the dam was then dependent on the arrangement of opened gates. Similarly, at high stages diversion by pumping affected only a relatively small (but nevertheless definite) region of flow, since the pumping rate was only a small percentage of the total discharge. Under pooled conditions, of course, when a major part of the discharge was diverted, the primary flow was directed toward the pumps.

Two different patterns of sediment movement were thus obtained at the extreme ranges of stage, a combination of the two being present under intermediate conditions. At high stages, when a pool was not formed, the diversion of water also resulted in the diversion of sediment. Since the greater part of the annual sediment load would be transported during such flows, protection of the pump intakes for this condition became vital. At the other extreme of river discharge, the pool would tend to act as a large stilling basin for any incoming sediment load. At the same time the flow directed toward the pumps would tend to transport into the intakes any material previously deposited. Thus protection—although of a different nature—would still be required.

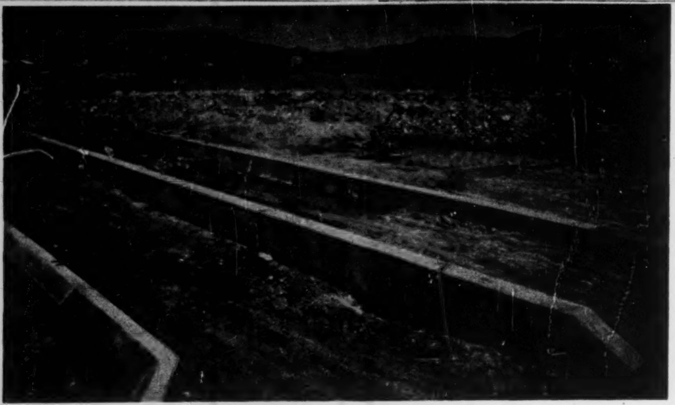
Most of the customary methods of sediment control were rejected because of the special requirements and inherent limitations of the case in question. The fixed location of the pump house precluded the use of off-channel stilling basins. Traps suitable for all flow conditions and constructed within the river section would probably result in undesirable backwater. Reduction of trap size by the inclusion of mechanical cleaning equipment would be unduly expensive. The sole use of vortex tubes or similar systems was impracticable, since at low flows little or no water could be wasted. However, preliminary tests indicated that a series of low sills at the pump intakes, arranged in a manner previously suggested by the Institute, would either divert or trap the oncoming sediment in an altogether satisfactory manner.

After preliminary tests on various alternative sill heights and locations (Fig. 4), the arrangement shown in Fig. 5 was recommended because of its superior model performance. With the Tainter gates open at flood stage, the greater part of the bed material approaching the intakes was deflected by the outer sill and carried downstream. Spiral eddies formed behind both the outer and intermediate sills would sluice on through the end gates any material passing over the sills.

At low stage, when the entire discharge of the river was being pumped, the sills would serve as a settling basin. Any sizable material then carried over the sills settled into the eddies and was swept away from the pump intakes. Only a slight opening of the Tainter gates adjacent to the pump house then instituted a self-cleaning action. Noteworthy is the fact that at moderate rates of flow the best protection was obtained by operation of the gates nearest the sills. It was found, moreover, that the natural deflecting action of the slanting rock ridge could be intensified by the construction of a tapered groin in the break between the ridge and the right bank (see broken line in Fig. 2).

On the basis of these observations it was concluded that the cumulative effect of the successive structures should reduce to a minimum the probability of any sand or gravel entering the pump intakes. Material so fine as to be carried in suspension will not be excluded, although the skimming action of the sills should tend to reduce the amount of such material in the diverted flow.

Since maintenance of minimum downstream flow at the Paraiba diversion required knowledge of the discharge characteristics of the Tainter gates, a half-model of one gate was installed in an existing $2^1/_2$-ft channel in the Institute laboratory. The size of the model was thus fixed, corresponding to a scale of 1:13.88. The discharge through the gate was then determined as a function of the headwater, the gate opening, and the



DIVERSION of bed-load sediment from intakes to Santa Cecilia Pumphouse (Fig. 2) was among most interesting of knotty problems solved by model studies for Paraiba-Pirai diversion project. After rejection of most customary solutions, a series of concrete sills was built as shown in photo above and in Fig. 5 below.

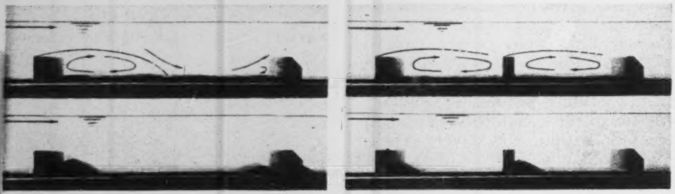


FIG. 4. **MODEL TESTS** on various sill heights and arrangements showed eddy patterns. Pattern without intermediate sill (left) and with it (right) led to adoption of intermediate sill, as shown in Fig. 5 below. Sills parallel with river flow facilitated sluicing action when spillway gates immediately downstream were opened.

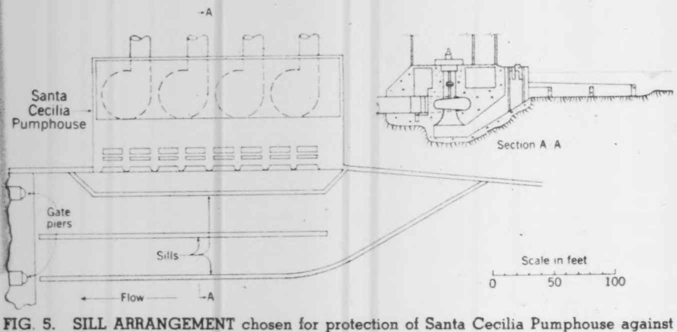


FIG. 5. **SILL ARRANGEMENT** chosen for protection of Santa Cecilia Pumphouse against heavy sediment load in Paraiba River was result of model studies.

tailwater. A composite dimensionless plot of the resulting discharge is presented as Fig. 22 in Chapter VIII of *Engineering Hydraulics* (Wiley, 1950). The effect of single and multiple gate openings was not investigated, as the cost of such studies was not justified by the relatively small increase in accuracy which it would permit.

For studies of the Sant'Ana Spillway, a 1:30 model of a single bay was installed in the $2^1/_2$-ft channel, and the calibration curves of the spillway for both ungated and gated discharge were determined. Also included in the investigation was the angle of the wing wall at the side of the spillway. By varying the flare between the wall and the direction of flow, it was found that an angle of about 7 deg gave the best flow pattern. At lesser flare a zone of high velocity existed along the base of the wall, and at greater flare a pronounced upward boil appeared at the end.

Since velocities of the order of 30 fps were to be anticipated at the toe of the spillway, the need for some kind of protection was readily apparent. An upturned bucket was not considered practicable, since large flows might be discharged over the spillway during periods of low tailwater. A long apron could be used, but after preliminary tests with baffle piers it was considered to be needlessly expensive. The final pier arrangement was selected on the basis of relative scour tendency as reflected in the time required to erode a bed of $^1/_4$- to $^1/_2$-in. limestone gravel downstream from the baffles; approximately a thousand-fold difference existed between the observed times for the best and the worst conditions.

Under the possible—albeit rare—condition of high discharge and very low tailwater, a jump was not formed with the arrangement recommended; instead, a sheet of water was deflected upward by the piers and impinged on the bed a short distance downstream. The cost of depressing the bucket to remedy this situation was not considered justifiable in view of its probable rarity of occurrence. Since a rock weir a short distance downstream from the spillway was found to create the tailwater necessary to form the needed jump, this simple expedient was recommended.

The pressure distribution on the face of the spillway was checked, and found satisfactory, for all conditions of flow. Later the model and its incorporated piezometer holes were utilized in a study of the forces on submerged low dams.

The layout of the Santa Cecilia Canal (Fig. 6) required the use of three large transition structures: No. 1, an expansion from a rectangular tunnel portal to an earth canal; No. 2, a contraction from the earth canal to a lined rock cut; and No. 3, an expansion from the rock cut to another earth canal. Both expansion structures involved special design problems. At the site of No. 1, the foundation conditions were particularly poor; therefore, a short structure was desired, but it was considered essential to produce a relatively uniform velocity distribution at the exit with a maximum velocity not over 25 percent greater than the mean. Since Transition No. 3 was not only preceded by a curve but also located at the beginning of another, these requirements were even more difficult to fulfill. In the absence of any analytical procedure which could be used with confidence for the investigation of the flow in the expansions as designed, a model study was clearly necessary.

Concrete models of the original proposed designs were constructed at a 1:25 scale as shown in Figs. 7 and 8. The maximum expected flow of

5,660 cfs was used in all the tests, reduced in the model, of course, according to the Froude relationship. Several methods were used to evaluate the model performance. The most complete quantitative information was obtained by determining the velocity distribution with a pygmy current meter at various critical sections—especially at the end of the transition structure. Water-surface profiles and velocity distributions provided a measure of the head loss and revealed the zones of high turbulence and energy dissipation. A qualitative picture of the surface flow pattern was obtained by photographing floating candles.

The performance of the original designs was characterized by early separation from the walls and a high-velocity jet which was both asymmetric and unstable. The maximum velocity at the exit of both structures was 9 fps as compared with the mean of 3.25, a reduction of 3 fps from the approach velocity in Transition No. 1 and of only 1 fps from that in Transition No. 3. Eddies were formed at each wall (Fig. 7), and the jet persisted for a considerable distance downstream. Since Transition No. 1 had been designed with a flare greater than commonly used, for comparison purposes another transition model was built employing the usual flare angle of 12°30′. Only a slight improvement resulted, as evidenced by a maximum velocity of 8 fps at the exit.

The success of vanes as flow guides in wind tunnels and conduit transitions then led to the development of a transition relying on splitter walls to expand the flow. These walls in effect divide the flow into a number of sections and expand each separately; the flare in any one section thus remains small enough to prevent separation, while the total flare is rapid enough to result in a comparatively short structure. The half angle chosen as the basis of the design was 3°30′, the use of four intermediate walls thereby shortening the structures to approximately 110 ft, a reduction in length of 85 ft from the original designs. The vaned models shown in Figs. 7 and 8 were constructed and tested, with very satisfactory results. Warped sidewalls, as shown at the left, were included in the first design; however, equal performance resulted with the simplified structural form at the right.

At the exit of the structures the velocity distribution was slightly serrated, but the maximum velocity was only 4.1 fps, and within 30 ft was reduced to 3.6, less than 15 percent above the mean. In the case of Transition No. 3 it was necessary only to shift the leading edges of the splitter walls slightly to compensate for the non-uniform approach conditions. Not only was the head loss in the vaned transitions 25 per cent less than that of the original designs, but in addition completely normal flow conditions were realized a short distance downstream. Under difficult foundation conditions the added cost of the splitter walls may be more than offset by the economy of reduction in transition length.

All the studies here described were performed for Canadian-Brazilian Services, Ltd., of Toronto, Canada, and the Rio de Janeiro Tramway, Light and Power Co., Ltd., under the supervision of Hunter Rouse, M. ASCE, Director of the Iowa Institute of Hydraulic Research. The study of bed-load diversion was conducted by the writer; that of the Santa Cecilia Tainter gates by D. E. Metzler, Research Engineer; that of the Sant'-Ana spillway by P. N. Lin, Research Associate; and canal transitions by J. P. Craven, Research Associate.

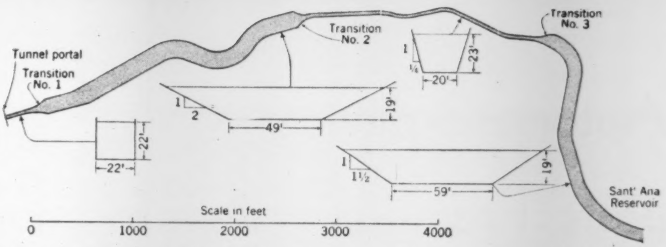
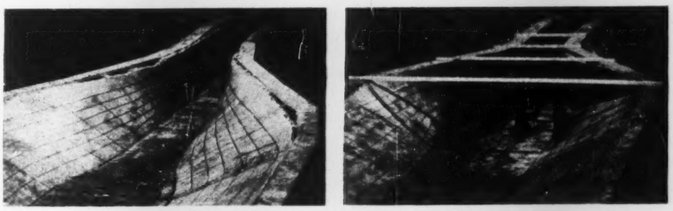


FIG. 6. **DESIGN OF TRANSITIONS** on Santa Cecilia Canal were subject of another model study of special interest. Transition No. 1 is expansion from rectangular tunnel portal to earth canal; No. 2, contraction from earth canal to lined rock cut; and No. 3, expansion from rock cut to another earth canal. Transitions Nos. 1 and 3 were chief problems, and results of studies are shown below, in Fig. 7 for Transition No. 1, and in Fig. 8 for No. 3.



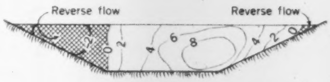
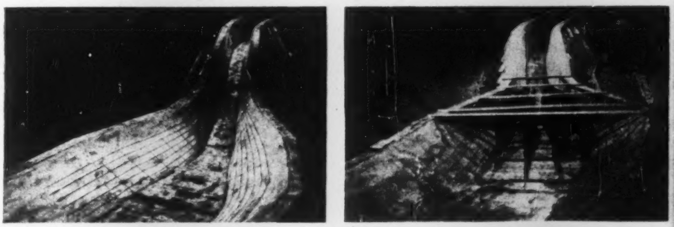


FIG. 7. **CONCRETE MODEL** to 1:25 scale for initial design of Transition No. 1 showed poor results, as seen in flow pattern at left. This model is seen at left above. Second model, at right above, solved problem by means of flutter walls to spread flow rapidly without excessive scour.



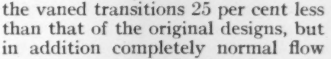


FIG. 8. **CONCRETE MODEL** for initial design of Transition No. 3, seen at left above, showed flow pattern at left, undesirable because of eddies at each wall and jet which persisted some distance downstream. Again flow guides solved problem, as seen in successful model above.

Automatic devices protect aeration system for Philadelphia Sewage Works

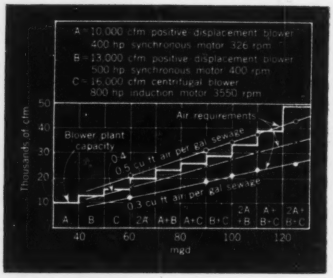


FIG. 1. AIR REQUIREMENTS OF SEWAGE are met in steps as flow increases. Blower system consists of two "A" units, one "B," and one "C."

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ADEQUATE CAPACITY, efficient continuous operation, and automatic protection against all emergencies were the three basic criteria which governed the design of the aeration system for Philadelphia's new Northeast Sewage Treatment Works. This plant, to be placed in operation in the near future, operates on the modified aeration principle to treat a maximum flow of 125 mgd. (See article by Samuel S. Baxter, M. ASCE, Civil Engineering for July 1950, p. 40.)

Design of the aeration system began with a study of present and expected future rates of sewage flow throughout a 24-hour day. Then followed an analysis of the air requirements for the expected variations in flow, at several aeration rates, in order to be certain that the system would be adequate but not of excessive capacity. The results of this study are shown in Fig. 1.

Four Blowers Installed

Next was the development of a blower system—a combination of the types and capacities of blowers best suited to furnish the required air. Centrifugal blowers can be operated at variable capacity by the installation of a valve in the blower suction line for throttling the suction flow, but with loss in efficiency. Some plant operators in other cities prefer centrifugal blowers because their capacities can be varied by throttling, while others prefer the positive-displacement type because at constant speed they deliver a practically constant volume of air regardless of air temperature or density.

In order to attack the problem objectively, characteristic blower performance curves, obtained from several representative blower manufacturers, were carefully analyzed. After a study of four separate blower installations, of both centrifugal and positive-displacement type, a combination of two 10,000-cfm, one 13,000-cfm, and one 16,000-cfm blower was selected as the most efficient for the requirements of this plant. The two 10,000-cfm and the one 13,000 - cfm positive - displacement blowers are identical. The larger capacity is obtained by a higher-speed and a larger-capacity motor. When the future plant expansion requires more air capacity, the present air capacity of 49,000 cfm can be increased to 55,000 cfm by replacing the two 400-hp motors with 500-hp motors.

Since the study of centrifugal blowers indicated a power loss varying from 5 to 10 percent when throttling from 10 to 30 percent, this installation is restricted to one 16,000-cfm centrifugal blower. With various combinations of the blowers in this installation, Fig. 1, almost all required variations in air flow can be obtained without throttling any blower. However, to provide even greater flexibility of operation, a 24-in. manually operated butterfly valve was installed in the suction line of the centrifugal blower.

All the blowers were made by the Roots-Connersville Blower Corp. of Connersville, Ind.; the synchronous motors by the Electric Machinery Manufacturing Co. of Minneapolis; and the squirrel-cage induction motor for the centrifugal blower by the Elliott Co. of Ridgway, Pa.

The blowers discharge into the air system as shown in Fig. 2. Since all the blowers discharge into a common discharge line, provisions must be made for quickly shutting off any blower from the line. Without this provision the motor failure of any blower would allow the air under pressure in the discharge main to flow back through the stalled blower, rotating it in reverse at such speed as to damage the motor. With a 7-lb pressure in the discharge line, this would happen in a few seconds.

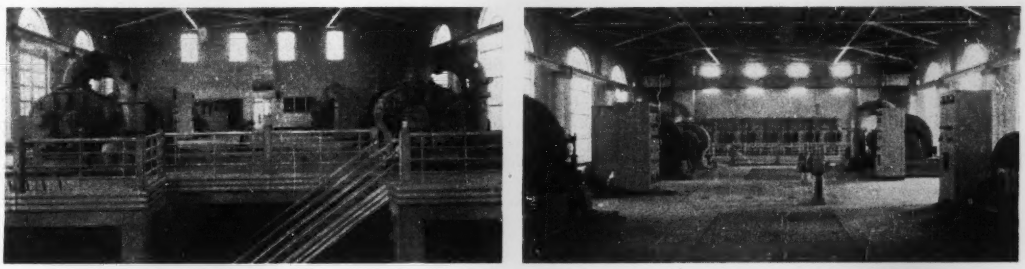
Conventional drives on 24-in. discharge gate valves, which were considered for each blower discharge, would take one minute to shut the gate, entirely too long to avoid damage. Check valves were also rejected since they do not hold up in a blower discharge system composed of positive-displacement-type blowers with their pulsating discharge. On account of the large suction and discharge piping and silencers in our installation, space for cone valves was not available. Also, cone valves are still very expensive.

The final solution was to install a quick-operating butterfly valve on the suction line of each blower. This valve, which is solenoid controlled, weight operated, and equipped with a specially designed mechanism for manual reset, will automatically shut instantly when motor failure occurs or when power is cut off to take a blower off the line. Reverse flow through any blower is thereby prevented.

Protective Controls and Indicating Devices

The blower system is protected against possible emergency conditions—such as overload, undervoltage, power failure, phase failure, motor failure, overheating, or lubricating-oil-pressure failure—by numerous controls, interlocking devices, limit and pressure switches for the prompt and automatic shutdown of any blower unit. These controls are in addition to the indicating instruments, gages, thermometers, and meters normally used on such units.

Indicating lamps with green and red color caps and label plates



BLOWER ROOM contains four units, discharging into single line, which are electrically connected and interlocked against emergencies that might damage any unit. Rate at which air is furnished to four aeration tanks of 125-mgd capacity each, is displayed on large dial actuated by Selsyn transmitter, alongside of dial indicating total sewage flow rate. Blower room is ventilated, and heated or cooled according to season, by complete air-conditioning equipment. Windows and doors are kept closed to eliminate dust.

mounted on the control panels, show the operator at a glance whether suction or discharge valves are open or closed. Flashing lamps flash during the operation of units such as auxiliary oil pumps, which normally operate only at the start and shutdown of a blower unit, and while the bypass valve on positive-displacement blowers is open, which occurs only during starting. The flashing lamps are to call the operator's attention to conditions that should exist only temporarily during the procedure of starting or shutting down a blower.

The entire system of controls and indicating devices was designed to clearly indicate the operation of all important parts of the blower system, and to make it impossible for an operator to damage a blower unit when placing it on or taking it off the line, or for a blower unit to be damaged because of any emergency condition.

In placing a positive-displacement blower in operation, the interlocking and control devices make it impossible to start the blower unless the following operations have been first completed:

(*a*) Blower discharge valve is closed.
(*b*) Blower suction valve is open.
(*c*) Blower auxiliary lubricating oil pump is in operation, and oil pressure has reached at least 5 psi.
(*d*) Blower unloader bypass valve is open.
(*e*) Motor-generator set (d-c) is in operation, supplying field excitation current to the synchronous motor of the blower.

On the control panel for each blower, labeled colored lamps light up, indicating that items (*a*), (*b*) and (*e*) are in proper position or operating; and flasher lamps start indicating that item (*c*) is in operation and (*d*) is open. The circuit for starting the blower is closed only when the unloader bypass valve is open, since positive-displacement blowers should be started at no load. When all these conditions are met, the controls and interlocking devices will permit the operator to remove a key from the auxiliary lubricating oil-pump motor switch, insert it in the blower-motor control switch, and start a positive-displacement blower.

When a blower unit starts operating, its shaft-driven, main lubricating oil pump also starts, and as the speed accelerates, the pump builds up the oil pressure required for normal operation. When the lubricating oil pressure reaches 7 psi, a pressure switch opens and shuts down the auxiliary oil-pump motor, and extinguishes the flasher indicating lamp on the control panel labeled "auxiliary oil pump."

After the positive-displacement blower has reached full operating speed, it must be loaded before it is placed on the line. Load is applied gradually by manually closing the bypass valve to a nearly closed position, and raising the blower discharge pressure to 8.5 psi. At this pressure a control device whose contact is in the discharge valve "open" control circuit, lights an indicating lamp on the blower to show the operator that the proper discharge pressure has been reached. It is now possible to open the blower discharge valve by its push-button control, following which an indicating lamp labeled "discharge valve open" on the blower control panel starts flashing, to remind the operator that the unloader bypass valve still has to be fully closed. When the discharge valve is in the fully open position, a limit switch automatically stops the valve drive motor.

This pressure control feature was incorporated in the system to prevent a rush of air from the discharge main, which is under pressure from other blowers, into a blower being placed on the line when the blower's discharge valve is opened. By building up the discharge pressure of the blower to slightly more than the line pressure before placing the blower on the line, no interference to blower operation will result when the discharge valve is opened.

If for any reason the operator should fail to open the discharge valve, when all the operations described above have been performed and the blower is operating but not yet on the line, the air continuously bypassing through the blower would be heated to the point where blower parts would be damaged. A temperature control was therefore provided in the blower casing, which will shut down the blower motor and suction valve automatically when the air temperature reaches 215 deg.

At this stage, the indicating lamp on the control panel labeled "discharge valve open" is still flashing and the indicating lamp on the blower is still lighted, indicating to the operator that the blower starting operation is not yet complete. When the operator has manually closed the unloader bypass valve completely, a limit switch on this valve extinguishes the red indicating lamp on the blower and simultaneously stops the flashing of the "discharge valve open" lamp. The operations for starting and placing a blower on the line are now completed.

The starting operation, controls and interlocking devices, and indicating lamps for the centrifugal blower are similar to those for the positive-displacement blowers, except those pertaining to the unloader bypass valve, since centrifugal blowers can start under a shutoff head requiring no "unloading" bypass. Also, since the centrifugal blower is driven by an induction motor instead of a synchronous motor, there is no field excitation, and step (*e*) is not required. However, the air-temperature control device was also installed on the centrifugal blower for automatic shutdown in case the discharge air temperature should rise to 215 deg. F.

Blower Shutdown Operation and Controls

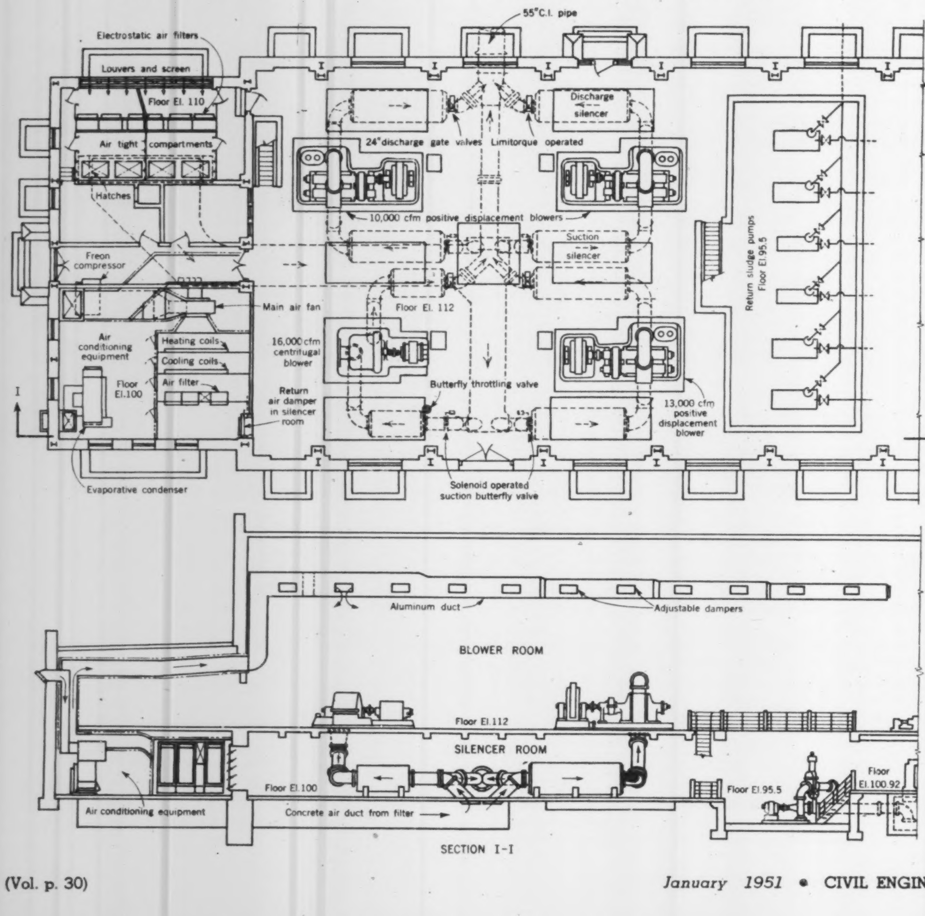
For normal manual shutdown of any blower, the operator turns the blower-motor control switch to the "off" position. Simultaneously, the solenoid-controlled suction butterfly valve closes automatically, preventing any reverse flow through the blower. The green indicating lamp on the control panel labeled "suction valve open" goes out, and the red lamp labeled "suction valve closed" lights up. The discharge valve also starts to close automatically. When this valve is fully closed, the torque mechanism on the valve drive shuts down the valve-drive motor. The red indicating lamp on the control panel labeled "discharge valve open" goes out, and the green indicating lamp labeled "discharge valve closed" lights up.

Because in this installation the suction butterfly valve closes instantly without shock when the blower-motor control switch is turned to the "off" position, it is not necessary in the shutdown procedure to close the discharge gate valve before the blower motor is stopped, as would be required in other blower installations.

As the blower decelerates to a stop, its main lubricating oil pump also decelerates, reducing the lubricating oil pressure. When the oil pressure drops to 5 psi, a pressure switch in the control circuit automatically starts the auxiliary oil pump and a flasher lamp on the control panel labeled "auxiliary oil pump" starts to flash, indicating an incompleted procedure. The operator then removes the key from the blower-motor control switch, inserts it in the auxiliary oil-pump motor control switch, and manually stops this pump motor. The "auxiliary oil pump" flasher immediately stops automatically.

The feature of the removable key to operate both the blower motor and the auxiliary oil-pump motor control switches, was incorporated to make it impossible to manually start or stop these two motors in the wrong sequence. This procedure

FIG. 2. BLOWER PLANT of 49,000-cfm capacity, takes air through electrostatic filters and is completely air conditioned.


55°C.I. pipe
Electrostatic air filters
Louvers and screen
Floor El. 110
Air tight compartments
Hatches
Discharge silencer
24" discharge gate valves
Limitorque operated
10,000 cfm positive displacement blowers
Suction silencer
Freon compressor
Main air fan
Floor El. 112
Air conditioning equipment
Heating coils
Cooling coils
Air filter
Floor El.100
16,000 cfm centrifugal blower
Return air damper in silencer room
Butterfly throttling valve
13,000 cfm positive displacement blower
Return sludge pumps Floor El.95.5
I
I
Evaporative condenser
Solenoid operated suction butterfly valve
Aluminum duct
Adjustable dampers
BLOWER ROOM
Floor El.112
SILENCER ROOM
Floor El.100
Air conditioning equipment
Concrete air duct from filter
Floor El.95.5
Floor El.100.92

SECTION I-I

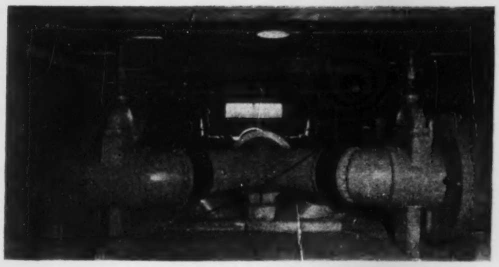
assures the presence of oil pressure on equipment bearings, before equipment is started and until after it has stopped.

To provide filtered air to the diffuser system, a room was laid out at one end of the blower building. This room is divided into two separate air-tight compartments, each with one automatic and self-cleaning electrostatic air filter of 46,700-cfm capacity at 500-fpm air velocity. One filter unit is adequate for normal operation; the second is a standby.

Each air-tight compartment is provided with air-tight hatches in the floor at the entrance to concrete ducts below the blower-room floor, leading to the blowers. Each compartment is so designed that one filter unit can be serviced, repaired, removed, or replaced while the second unit is in continuous operation. To prevent entrance into a compartment while high-potential current is flowing to the filters, safety switches automatically cut off the power supply when the doors are opened.

The piping system is designed to maintain air-flow velocities from 40 to 50 fps. The entire distribution system is made of cast-iron pipe and fittings, except for a few large special fittings in the blower building, which could be fabricated more economically of $^1/_4$-in. galvanized steel plate, and the diffuser risers, which are of wrought-iron pipe.

Suction and discharge pipes are attached to the blowers with special rubber joints to take care of expansion and contraction, and to prevent the transmission of vibration from blowers to piping system. For maximum noise-level reduction, baffled silencers of the two-chamber type have been installed on the suction and discharge piping of each positive-displacement blower, and "straight-through" type silencers on the suction and discharge piping of the centrifugal blower.



ALL BLOWERS discharge through insulated silencers and piping into single cast-iron line leading to aeration tanks. Ends of large cylindrical silencers are seen at each side of photo.

The piping layout for the aeration tanks is shown in Fig. 3. To provide a shutoff, and also a means of balancing the system to obtain equal flow of air in each of the eight supply lines, a butterfly valve is provided at the head of each trunk line supplying the diffuser system. The reduction in size of piping along the run of each supply line is proportioned to obtain an equal air flow to each diffuser, and to hold the pressure drop from the influent end to the far end of the supply line within 1.7 in. of water column, assuring uniform air distribution to all diffuser tubes.

Swing diffusers are installed in the aeration tanks with diffuser tubes of 3-in. inside diameter, 24 in. long, and spaced on 12-in. centers. This system makes it possible to replace and clean the tubes without dewatering the aeration tanks. Both ceramic and precision-type tubes will be used.

The pressure drop for the distribution and diffuser system on the discharge side of the blowers was calculated, assuming an air temperature of 68 deg F, a temperature rise due to compression of 60.6 deg F, and an average air flow of 36,000 cfm. The pressure drop is 1.06 psi, which, added to the 13-ft head of water on the diffuser tubes in the aeration tanks, establishes the discharge pressure required for the blowers.

The design of the air distribution system is so balanced, by the proper proportioning of the pipe sizes, that the calculated difference in total pressure drop at the end of the first supply line and at the end of the eighth supply line is only 0.03 psi.

Air-flow losses on the suction side of the blowers were also carefully cal-

EACH OF EIGHT air pipelines feeds swing diffusers in two aeration channels, one on each side. Diffuser tubes, of 3-in. diameter and 24-in. length (not yet installed in this view), can be replaced without dewatering tank.

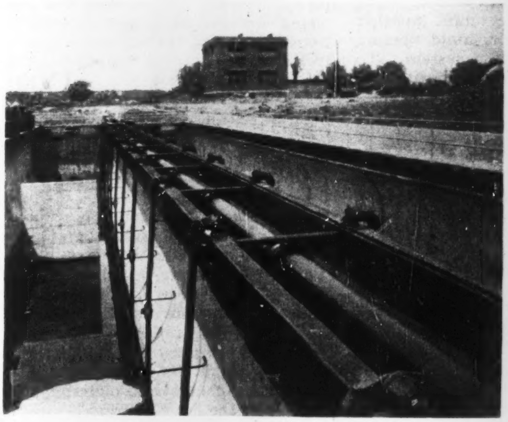
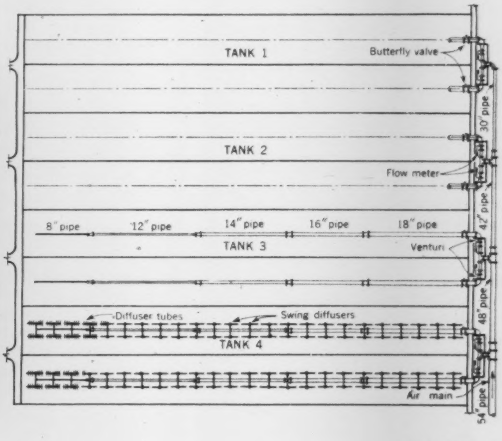


FIG. 3. **PLAN** of aeration tanks shows arrangement whereby single cast-iron main of decreasing diameter feeds air to eight pipelines which likewise decrease in diameter as they pass from one end of tanks to the other.



culated, accounting for losses through filters, hatches, concrete duct, silencer fittings, and suction piping. These losses established a total vacuum on the blowers of 7.37 in. of water column.

To allow for variations in inlet air temperatures and total air flow, which affect pressure drop, the blowers were specified to deliver their rated capacities at a discharge gage pressure of 7.7 psi, a suction pressure of 14.5 psi absolute, and an inlet air temperature of 68 deg F.

To indicate the air flow in each of the eight supply lines, a Venturi meter with flow indicator and totalizer register is provided at the head of each line at the aeration tanks. By observing these air-flow meters and adjusting the butterfly valve at the head of each line, the flow in the lines can be kept equalized. Flow readings from each air-flow meter are transmitted to an indicating and recording meter in the blower building where the flows are summated.

The total rate of flow is recorded on a daily chart, and integrated on a totalizer register. A Selsyn transmitter at the recording meter transmits the indicated total rate of air flow to a large dial indicator, conspicuously placed on the wall of the blower room, adjacent to a similar dial indicating the total rate of sewage flow to the plant. With these continuously indicating total-flow dials, the blower operator can easily maintain proper air-flow volumes.

For reasons of economy, the motors for the blowers are of the conventional open type. Motors of this type require periodic dismantling to remove dust accumulated in and on their windings. To provide against reduced air capacity resulting from shutdowns, and the labor costs involved, the blower room is designed to eliminate dust. Its doors and windows will be kept closed at all times, and it will be ventilated, heated, and cooled by filtered air from the air conditioning system.

Design of the system required handling the heat liberated in the blower room, resulting from the frictional horsepower of all operating equipment and the heat of compression from the blowers, calculated at 362,000 Btu per hour.

Calculations for the design of the air conditioning system revealed that the heat liberated from the large blower discharge piping in the silencer room during summer, assuming an outside air temperature of 95 deg F and including the heat of compression from the blowers, would require 30 tons of refrigeration to cool the inside air to 85 deg F. Also, the transmission losses for the blower suction piping in the silencer room in winter, assuming an outside air temperature of 0 deg F, would require 90 lb of steam per hour to bring the inside temperature to 65 deg F. By completely insulating both suction and discharge piping with 85 percent magnesia insulation, the refrigeration load was reduced from 30 to 3.7 tons, and the heating load from 90 to 11 lb of steam per hour for these two items.

Requirements for the air conditioning system were: an air-fan capacity of 30,000 cfm; make-up air at 5,700 cfm to take care of filtration; a 60-ton refrigeration unit; and a heating load of 1,000 lb of steam per hour at 10-psi pressure.

The control-station type of conditioning system was specified, utilizing mechanical air filters of the self-cleaning type, cooling coils and heating coils all contained in an insulated compartment; and an insulated main air fan and aluminum duct work discharging air into the blower room for return through the silencer room. A 60-ton reciprocating-type compressor for Freon-12 refrigerant was specified, with cylinder-head unloaders to obtain variable capacity in steps down to 50 percent of the rated capacity. Also incorporated for completely automatic operation were an evaporative condenser, exhaust fan, motor-operated aluminum dampers, heating and cooling thermostats, damper and motor controls, temperature controllers, firestat, and modulating steam valve.

Considering all the heat generated in the blower room by the operating equipment, computations indicated that when the outside air temperature is between 50 and 80 deg F, the inside temperature will be between 65 and 85 deg F, without heating or cooling, if all the circulated air is discharged to the outside. During mild weather therefore, the system could operate merely as a ventilation system. To take advantage of this situation, increase operating efficiency, and minimize operating costs, a system of controls was designed to perform the following cycles of operation automatically:

1. In the spring, when the outside air temperature rises to 50 deg F, one temperature controller in the outside air intake closes contact, causing: the intake air damper to open; the return air damper to close; the exhaust air fan to start operating, exhausting all air circulated through the blower and silencer rooms to the outside; and the main air fan and filter motors to continue to operate. The conditioning system then is operating on a filtered-air ventilation cycle.

2. In the summer, the Freon compressor and evaporative condenser are placed in operation by closing a control switch. When the outside air temperature rises to 80 deg F, a second temperature controller in the outside air intake opens contact, causing: the outside air damper to close, leaving open only a small fixed outside-air damper for "make-up" air; the return air damper to open; the exhaust air fan to stop; and the main air fan and filter motors to continue to operate. The cooling thermostat in the blower room automatically controls a Freon solenoid valve connected with the cooling coils in the conditioning unit, and set to maintain the inside temperature between 81 and 85 deg F. The conditioning system then is operating on a filtered-air cooling, recirculating cycle.

3. In fall, the Freon compressor and evaporative condenser are deenergized by opening the control switch. When the outside air temperature drops below 80 deg F, the second temperature controller closes contact causing the same operations described under Cycle 1. The conditioning system then is operating on a filtered-air ventilation cycle.

4. In winter, when the outside air temperature drops below 50 deg F, the first temperature controller opens contact, causing: the outside air-intake damper to close, leaving a small fixed outside air damper open for "make-up" air; the return air damper to open; the exhaust air fan to stop; and the main air fan and filter motors to continue to operate. The heat thermostat in the blower room automatically controls a modulating steam valve connected with the heating coils in the conditioning unit, and set to maintain the inside temperature between 65 and 70 deg F. The conditioning system then is operating on a filtered-air heating, recirculating cycle.

A safety cutoff installed in the air duct near the main air fan will immediately shut down this fan automatically whenever the temperature in the duct rises to a point indicating the presence of fire.

Control systems for the blowers were developed with the cooperation of Louis Kusner, electrical engineer for the Bureau. Mr. Kusner was also responsible for the design, specifications, and testing of the power and control circuits, electrical equipment, and the large blower motors. Alex Maltman, Assoc. M. ASCE, structural engineer, was responsible for the structural design and specifications for the blower building, aeration tanks, and the massive reinforced concrete foundations for the blower units. Philip G. McDowell, architect, was responsible for the architectural design and specifications for the blower building. The writer was responsible for the basic studies, design, specifications, and testing of the aeration system, involving air filtration, compression, transmission, and diffusion, the air-conditioning system, all mechanical equipment, control and metering systems, and the large blowers.

Engineers' Notebook

Short Cut Anticipates Distribution of Returning Moments

ELIHU GEER, M. ASCE, Professor and Director, Civil Engineering Department, University of Detroit, Detroit, Mich.

IN MANY PROBLEMS of moment distribution it is advantageous to anticipate the moments which will return to a joint, and to distribute in advance an amount which includes compensation for such returning moments. Where applicable, this process is less tedious and more satisfactory than the conventional method of limiting the number of cycles and accepting the resulting inaccuracy.

In Fig. 1 is shown a three-span continuous beam having distribution factors d_1, d_2, d_3, and d_4; carry-over factors c_1 and c_2; and an unbalanced moment of u at joint C. Moments at joint B have been balanced.

In the process of balancing moments at joint C, a moment of $-c_2d_3u$ will be carried over to joint B. Balancing of moments at joint B returns a moment of $c_1c_2d_2d_3u$ to joint C. Let $c_1c_2d_2d_3 = a$. Now the unbalanced moment at joint C is au. The next cycle will return a moment of a^2u.

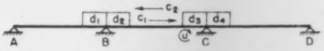
Each cycle thereafter will result in a higher power of a. Thus the entire amount which eventually must be distributed at joint C equals $(1 + a + a^2 + a^3 + \ldots + a^\infty)u = u/(1-a)$. Distribution of $u/(1 - a)$ at joint C in the first cycle will result in exact balance of moments at both B and C after carry-over to B, distribution at B, and carry over to C have been performed.

The method is equally applicable in structures having more than two joints at which moments must be distributed, provided only that no distributions have to be made at joints more than one span away from a central joint. In this case, the a factor for the central joint is equal to the sum of the a factors for all the members leading to this central joint. Moments should first be balanced at the outer ends of these members. The procedure thereafter is similar to that in the simpler case.

In Fig. 2 the method is applied to a four-span structure.

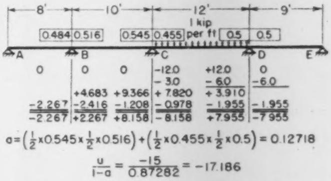
In Fig. 3 the method is applied to a problem in which more than two members meet at a joint, and in which the members meet at right angles. The procedure applies equally well in gable frames or other structures in which members meet at any angle. Although these examples deal with members of constant cross-section, the method applies without modification to members of varying cross-section.

For structures that do not meet the restriction given above regarding the number of joints, the method cannot be used in a form sufficiently simple to justify the effort. One alternative is to use the methods shown in Chapter IV of *Statistically Indeterminate Structures* by Maugh, combined with the method given here. Another alternative is to use the suggestion of Sir Richard Southwell, to "over-relax." The appropriate amounts may be apparent after one complete cycle has been carried through.



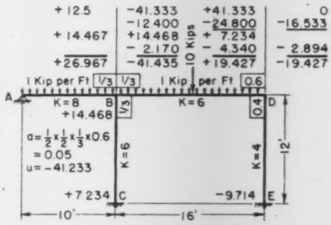
c_2
d_1
d_2
c_1
d_3
d_4
A
B
u
C
D

FIG. 1. **THREE-SPAN** continuous beam has distribution factors d_1, d_2, d_3, and d_4; carry-over factors c_1 and c_2; and an unbalanced moment of u at joint C.



8'
10'
12'
9'
1 kip per ft
0.484
0.516
0.545
0.455
0.5
0.5
A
B
C
D
E
0
0
0
-12.0
+12.0
0
- 3.0
- 6.0
-6.0
+4.683
+9.366
+ 7.820
+ 3.910
-2.267
-2.416
-1.208
- 0.978
- 1.955
- 1.955
-2.267
+2.267
+8.158
- 8.158
+7.955
-7.955
$a=\left(\frac{1}{2}\times 0.545\times\frac{1}{2}\times 0.516\right)+\left(\frac{1}{2}\times 0.455\times\frac{1}{2}\times 0.5\right)=0.12718$
$\frac{u}{1-a}=\frac{-15}{0.87282}=-17.186$

FIG. 2. **EXAMPLE ILLUSTRATES** application of short-cut method to four-span structure. Here members have constant cross-section, but method applies without modification to members of varying cross-section.



+ 12.5
+ 14.467
+ 26.967
-41.333
-12.400
+14.468
- 2.170
-41.435
10 Kips
+41.333
-24.800
+ 7.234
- 4.340
+ 19.427
0
-16.533
- 2.894
-19.427
1 Kip per Ft
1/3
1/3
1 Kip per Ft
0.6
A
K=8
B
+14.468
1/3
K=6
0.4
D
$a=\frac{1}{2}\times\frac{1}{2}\times\frac{1}{3}\times 0.6$
$=0.05$
$u=-41.233$
K=6
K=4
12'
+7.234
C
-9.714
E
10'
16'

FIG. 3. **EXAMPLE ILLUSTRATES** application of method to statically indeterminate structure in which more than two members meet in a point, and in which members meet at right angles. Procedure applies equally well where members meet at any angle.

... THE READERS Write

West Point No Longer Under Supervision of Corps of Engineers

TO THE EDITOR: On page 50 of the November 1950 issue there appears a discussion of the early history of civil engineering which contains an incorrect statement. The statement reads as follows:

"In the year 1802, West Point was founded, not primarily as a training school for officers, but to develop military engineers, and while its basic function has changed, *it has remained under the supervision of the Corps of Engineers ever since.*"

The italics are mine and indicate the portion which is in error.

The selection of Superintendents of the Military Academy was confined to the Corps of Engineers from the establishment of the institution in March 1802 to the passage of a law on July 13, 1866, which opened it to the entire army. Until the latter date, there had been 16 superintendents, all of whom were Corps.

of Engineer officers. It is interesting to note that from 1866 to the present there have been 25 superintendents, eight of whom have been Corps of Engineer officers. Probably the most famous is General of the Army Douglas MacArthur, then Brigadier General, 1919–1922.

The present Superintendent is Maj. Gen. Bryant E. Moore, who was an infantry officer.

West Point graduates are given a Bachelor of Science degree. Their educational preparation for professional engineering work is not quite adequate for a degree in engineering. It is a policy of the Corps of Engineers to assign their junior officers to leading civilian engineering schools for one year of advanced study. This graduate engineering education normally results in a Master's degree or the equivalent in engineering. West Point graduates normally will take a few undergraduate subjects during this school year, but have no difficulty in meeting the demands of graduate courses in such subjects as structures, hydraulics, or the legal and ethical phases of engineering.

L. J. Lincoln
Lt. Col., Corps of Engineers
District Engineer

Kansas City, Mo.

Empirical Formula for Bridge Waterway Areas Questioned

To the Editor: Robert B. Yule's article, "Bridge Waterway Area Formula Developed for Indiana," in the October 1950 issue, has caused considerable comment in highway circles, not because of the novelty of the formula but rather because more advanced methods of determining bridge waterways are being widely used.

A minor criticism is that dividing the number of years by the number of maximum floods is not a correct method of evaluating flood frequency. The frequency of floods can be easily estimated by a simple statistical method described by Dalrymple in Research Report 11-B, *Drainage*, of the Highway Research Board. The weakness in Mr. Yule's method is that one or more of the floods during the period of record might actually have a frequency of 100 or more years. Consequently, bridge waterways designed according to this criterion may be overdesigned.

A diagram such as that presented by Mr. Yule is useful for preliminary estimates of bridge waterways but ought not to be relied on for the final design of a bridge. The article does not state to what elevation the required waterway area is measured. If computed for the maximum high-water elevation based on local information, there is no certainty of the frequency with which that stage can be expected to be equaled or exceeded.

A more logical procedure is to develop flood frequency data for the particular stream, if stream flow records are available, or if not, from regional flood frequency studies as described in the article by Dalrymple cited above. The stage for a flood of given frequency can then be established from the rating curves of a nearby gaging station; or by determining the frequency of a flood of known stage and making appropriate adjustments; or, as a last resort, by computing a stage discharge curve. The bridge designer can then compute the backwater caused by the contraction of the flood flow for several alternate lengths of structure and select the length which keeps the backwater within tolerable limits. This procedure recently applied to a site in Indiana resulted in reducing the proposed bridge from five spans to three spans.

Mr. Yule is correct in his statement that an empirical formula should never be used blindly. As a matter of fact, an empirical formula or diagram should not be used if a better, practical method is available.

Carl F. Izzard, Assoc. M. ASCE
Chief, Hydraulics Branch, U.S.
Bureau of Public Roads

Washington, D. C.

Another Short-Cut Method Determines Water-System Pipe Sizes

To the Editor: In his article in the October issue, Mr. Hands presents a nomograph for the solution of complex water-main systems. I believe that the following method of solving this problem is much easier. The basic difference between the two methods is that "capacity factors" are used in the method here described instead of the "resistance factors" used by Mr. Hands.

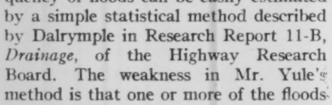


Fig. 1. Illustrative water system indicates method of solving for pipe sizes utilizing "capacity factors."

First, assumptions must be made of flows through each main in order to solve for K in the formula, $Q = K\sqrt{h}$. K is the capacity factor: Q, the quantity of flow in gallons per minute; and h the head loss in feet.

From standard Hazen-Williams tables the following K factors are arrived at:

Main Size, In.	Length, Ft	H. & W. Coef.	Assumed Q	h	K
12	5,000	90	1,000	22.7	210
16	3,800	150	1,000	2.55	625
10	3,800	75	1,000	51.2	140
12	5,000	100	1,000	20.5	221

These coefficients for the capacity factor K can then be written directly on a map of the water system, as shown in Fig. 1. This map clearly indicates the relative capacity of each main and shows up bottlenecks in the system. Flows through the various mains are directly proportional to the K values, and the K for the equivalent pipe for the system is the sum of the K's, or 1,196.

A further advantage in the use of this method is that head losses for bends, fittings and valves can be added to the pipe friction and the whole included in one coefficient.

The coefficients as shown in Fig. 1 are accurate to approximately 6 percent when the discharge is 5,000 gpm.

By recomputing the K's after the "assumed Q" is more definitely known, the head losses can be computed to any desired accuracy.

Benjamin C. Seal, Assoc. M. ASCE
Chief Office Engineer, Stone and
Webster Eng. Corp.

Richmond Heights, Mo.

AMERICAN SOCIETY OF CIVIL ENGINEERS

HOUSTON CONVENTION

RICE HOTEL, HOUSTON, TEX., FEBRUARY 21–23, 1951

Registration: Convention floor of Rice Hotel opens 2:00 p.m., Tuesday, February 20; each convention day 9:00 a.m. to 5:00 p.m. Registration fee (except ladies and students), $5.00.

Authors' Breakfasts

ROOM E **RICE HOTEL**

8:15	**Wednesday**	**February 21**
a.m.	**Thursday**	**February 22**
	Friday	**February 23**

Briefing sessions for all speakers, discussers and program officials by invitation. Presiding: Mason G. Lockwood, Chairman of Technical Program.

Welcome to Houston and ASCE Business Meeting

10:00 A.M. CRYSTAL BALLROOM RICE HOTEL

Presiding: Gail A. Hathaway, President, American Society of Civil Engineers

10:00 **Welcome to Texas**

By the Texas Section
RAYMOND F. DAWSON, President, Texas Section

By the City of Houston
MAYOR OSCAR F. HOLCOMBE

Response

GAIL A. HATHAWAY, President, American Society of Civil Engineers

11:00 **Presentation of The Daniel W. Mead Prize to Roy G. Cappel**

A word about the prize by MORRIS GOODKIND, Chairman, Committee on Professional Conduct

Presentation of the prize—GAIL A. HATHAWAY, President, ASCE, Acceptance—Roy G. CAPPEL, Jun. M. ASCE.

11:15 **General Business Session of ASCE**
Reports by the Executive Secretary
New Business

12:00 **Adjournment for membership luncheon**

Membership Luncheon—Wednesday, Feb. 21

12:30 P.M. CRYSTAL BALLROOM RICE HOTEL

GEN. W. F. HEAVEY, Director of the Port of Houston will address the convention. His subject will be:

Port Protection Measures

ROBERT J. CUMMINS, Houston Convention Chairman, will introduce the speaker.
All members, their ladies, guests and friends of ASCE are cordially invited to attend this luncheon. PRICE $2.25 per plate.

Wed. Afternoon, Feb. 21

Division Sessions

Irrigation Division

2:00 P.M. SOUTH AMERICAN ROOM 1

Presiding: W. E. Blomgren, M. ASCE; Member, Executive Committee, Irrigation Division

2:00 **Irrigation Potentialities in Texas**

H. P. BURLEIGH, Assoc. M. ASCE; Area Planning Engineer, U. S. Bureau of Reclamation, Austin, Tex.

2:45 **Ground Water in Texas for Irrigation and Municipal Water Supply**

W. L. BROADHURST, Ground Water Division, U. S. Geological Survey, Austin, Tex.

3:30 **Irrigation Water Rights in Texas**

H. E. BECKWITH, Assoc. M. ASCE; Texas Board of Water Engineers, Austin, Tex.

4:15 **The Role of Drainage in Irrigation**

C. R. MAIERHOFER, Assoc. M. ASCE; Head, Drainage Engineering Division, U. S. Bureau of Reclamation, Denver, Colo.

Air Transport Division

2:00 P.M. SAM HOUSTON ROOM

Presiding: Herbert H. Howell, M. ASCE; Chairman, Executive Committee, Air Transport Division

2:00 **New Airport Planning Tools Developed by Civil Aeronautics Administration**

C. LEYTON WILLIS, JR., Chief, Airport Planning Branch, Region Four, CAA, Fort Worth, Tex.

2:45 **Terminal and General Design, Friendship International Airport**

B. EVERETT BEAVIN, J. E. Greiner Co., Baltimore, Md.

3:30 **Redesign of Major Airport Terminals**

HERBERT H. HOWELL, M. ASCE; Chief, Airports Division, Region Five, CAA, Kansas City, Mo.

Soil Mechanics and Foundations Session

2:00 P.M. SOUTH AMERICAN ROOM A

Presiding: Philip C. Rutledge, M. ASCE; Chairman, Executive Committee, Soil Mechanics and Foundations Division, and Frank H. Newnam, Jr., M. ASCE; Member, Texas Section Committee on Soil Mechanics and Foundation Engineering

2:00 **Foundations of Controlled-Access Highways**

Soil Surveys and Anticipated Soil Problems on Turnpikes

B. W. LESUEUR, J. E. Greiner, Inc., Baltimore, Md.

2:30 **Foundation Designs—Dallas Freeways**

T. E. HUFFMAN, M. ASCE; Manager, Highway Department, Dallas Freeways, Dallas, Tex.

3:00 **Economies Effected Through Soils Engineering in Urban Expressway Design in Houston, Tex.**

FREDERICK A. HARRIS, Assoc. M. ASCE; Senior Designing Engineer, Texas Highway Department, Houston, Tex.

3:30 **Load Distribution Along a Model Bearing Pile**

LYMON C. REESE, Jun. M. ASCE; Assistant Professor, Civil Engineering, Mississippi State College.

L. HUDSON MATLOCK, JR., Jun. M. ASCE; Assistant Professor, Civil

Engineering, The University of Texas.

Raymond F. Dawson, M. ASCE; Professor, Civil Engineering, The University of Texas.

Dinner at the Shamrock

6:00 P.M. **EMERALD ROOM**
SHAMROCK HOTEL

Wednesday, February 21

A cocktail party and buffet dinner for ASCE at Houston's fabulous new hotel.

Dress will be informal, and the price for everything, including transportation if desired, will be $9.00 per plate.

Thursday Morning, Feb. 22

Student Chapter Faculty Advisers' Conference

9:30 A.M., Thursday, Feb. 22

All Student Chapter Faculty Advisers, Contact Members, or others especially interested in the activities and operational details of ASCE Student Chapters are cordially invited to take part in this round-table discussion of student affairs.

Division Sessions

City Planning Division

9:30 A.M. **SAM HOUSTON ROOM**

Presiding: L. V. Sheridan, M. ASCE; Member, Executive Committee, City Planning Division

9:30 **Modern Aspects of Industrial Zoning**

Dwight Wood, Chairman, Department of Economic Development, Lansing, Mich.

10:15 **Administration of a Zoning Plan**

Huber Smutz, Assoc. M. ASCE; Zoning Administration, City of Los Angeles, Calif.

Irrigation Division

9:30 A.M. **SOUTH AMERICAN ROOM 1**

Presiding: W. E. Blomgren, M. ASCE; Member, Executive Committee, Irrigation Division

9:30 **Falcón Dam, an International Structure**

Statement by:

David J. Herrera, Commissioner for Mexico, International Boundary and Water Commission, United States and Mexico.

Response by:

Lawrence M. Lawson, Hon. M. ASCE; Commissioner for the United States, International Boundary and Water Commission, United States and Mexico.

10:00 **Irrigation Developments Below Falcón Dam in Mexico**

Joaquin C. Bustamante, M. ASCE; Principal Engineer, International Boundary and Water Commission, United States and Mexico, El Paso, Tex.

10:30 **Potential International Developments Along the Rio Grande River**

C. M. Ainsworth, M. ASCE; Principal Engineer, International Boundary and Water Commission, United States and Mexico, El Paso, Tex.

11:00 **Interstate Water Compacts and Their Relation to Basin Development**

Royce J. Tipton, M. ASCE; Consulting Engineer, Denver, Colo.

Soil Mechanics and Foundations Division

9:30 A.M. **SOUTH AMERICAN ROOM A**

Presiding: Raymond F. Dawson, M. ASCE; Chairman, Texas Section Committee on Soil Mechanics and Foundations Engineering

Cofferdams and Cellular Bulkheads

9:30 **Soil Mechanics Features of the Design of Two Cellular Bulkhead Wharves**

S. J. Buchanan, M. ASCE; Professor, Civil Engineering, Texas A. & M. College.

10:15 **Stress Measurements in a Cellular Bulkhead Substructure**

Thomas W. Stallworth, Assoc. M. ASCE; Professor, Civil Engineering, University of Mississippi.

Edsel J. Burkhart, Research Assistant, Texas Experiment Station, Texas A. & M. College.

11:00 **General Features of the Construction of Cellular Structures**

Lawrence B. Feagin, M. ASCE; Colonel, Corps of Engineers, St. Louis District.

Structural Division

9:30 P.M. **CRYSTAL BALL ROOM**

Presiding: Jewell M. Garrelts, M. ASCE; Chairman, Executive Committee, Structural Division

9:30 **The Physiology of the Teredo—A New Approach to the Solution of the Marine Borer Problem**

Joseph F. Jelley, Jr., M. ASCE; Rear Admiral, C.E.C., U.S.N.; Chief, Bureau of Yards and Docks, Washington, D.C.

10:25 **Bridge Structures on Superhighways**

R. B. Alexander, Assoc. M. ASCE; Bridge Engineer, State Highway Department, Austin, Tex.

11:15 **Aluminum Storage Vessels**

E. C. Hartmann, M. ASCE; Chief Engineer, Design Division, Aluminum Co. of America, New Kensington, Pa.

F. L. Plummer, M. ASCE; Director of Engineering, Hammond Iron Works, Warren, Pa.

Rotary Luncheon

Thursday, February 22

12:15 P.M. **CRYSTAL BALLROOM**
RICE HOTEL

All ASCE Rotarians are cordially invited to attend this special luncheon of the Houston Rotary.

Thursday Afternoon

City Planning Division

2:00 P.M. **SAM HOUSTON ROOM**

Presiding: L. V. Sheridan, M. ASCE; Member, Executive Committee, City Planning Division

2:00 **Some Evidences of the Value of Expressways to the Communities Served**

Frank J. Balfour, Chief Right-of-Way Agent, Division of Highways, State of California.

Discussion:

William J. Van London, Houston, Tex.

3:00 **Off-Street Parking**

O. H. Koch, M. ASCE; Koch & Fowler, Consulting Engineers, Dallas, Tex.

Construction and Structural Divisions, Joint Session

2:00 P.M. CRYSTAL BALLROOM

Presiding: Ross White, M. ASCE; Member, Executive Committee, Construction Division, and Raymond Archibald, M. ASCE; Member, Executive Committee, Structural Division

2:00 **Design and Construction of Waterfront Structures**

Howard J. Hansen, Assoc. M. ASCE; Head, Structures Research Department, U. S. Naval Research and Evaluation Laboratory, Port Hueneme, Calif.

2:45 **Design and Construction of Baytown Vehicular Tunnel**

Design:

John O. Bickel, M. ASCE; Parsons, Brinckerhoff, Hall and Macdonald, Consulting Engineers, New York, N.Y.

Construction:

M. P. Anderson, Assoc. M. ASCE; Chief Engineer, Brown and Root, Inc., Houston, Tex.

Movies and Commentary:

William H. Bruce, Jr., Assoc. M. ASCE; Parsons, Brinckerhoff, Hall and Macdonald, Consulting Engineers, Houston, Tex.

Surveying and Mapping Division

2:00 P.M. SOUTH AMERICAN ROOM A

Presiding: S. A. Bauer, M. ASCE; Chairman, Executive Committee, Surveying and Mapping Division

2:00 **Texas Highway Department Surveys—Present and Prospective**

A. J. Van Dyke, Assoc. M. ASCE; Senior Resident Engineer, Texas Highway Department, Jacksboro, Tex.

Discussion

James A. Cotton, M. ASCE; Forrest & Cotton, Dallas, Tex.

2:45 **Dependence of the Oil Industry on Adequate Mapping**

George H. Lacy, M. ASCE; Chief Civil Engineer, Gulf Oil Corporation, Houston, Tex.

Discussion

W. H. Wilson, Humble Oil and Refining Company.

3:30 **Planning in the Cleveland Region Required Precise Control and Topographic Maps**

G. Brooks Earnest, M. ASCE; Professor of Engineering and Surveying, Case Institute of Technology, Cleveland, Ohio.

Discussion

E. D. Morse, Assoc. M. ASCE; Houston Lighting & Power Company, Houston, Tex.

Hydraulics Division

2:00 P.M. SOUTH AMERICAN ROOM 1

Presiding: George R. Schneider, Assoc. M. ASCE; Chairman, Executive Committee, Hydraulics Division

2:00 **Hydrologic Factors to Be Considered in Planning Flood Control and Multiple Purpose Projects in Texas**

M. A. Dillingham, Assoc. M. ASCE; Chief, Reports Branch, Corps of Engineers, Galveston, Tex.

2:30 **Hydrologic and Hydraulic Features of Design of Belton Reservoir**

William E. Wood, Assoc. M. ASCE; Engineer, Corps of Engineers, Galveston, Tex.

3:00 **A New Method of Computing Reservoir Sedimentation**

G. N. Burrell, M. ASCE; Head, Special Hydraulic and Sedimentation Section, Fort Worth District, Corps of Engineers.

3:30 **Radar—Tomorrow's Rain Gage**

Herbert E. Hudson, Jr., M. ASCE; Head, Engineering Subdivision, State Water Survey, Urbana, Ill.; and Glenn E. Stout and Floyd A. Huff, Meteorologists, Engineering Subdivision, State Water Survey, Urbana, Ill.

Dinner and Dance

Thursday, February 22

CRYSTAL BALLROOM RICE HOTEL

7:00 p.m. **Cocktail Hour**
8:00 p.m. **Dinner**
9:30 p.m. **Dancing and entertainment**

Ticket price will be $8.00 per plate. Dress will be optional.

Friday Morning, Feb. 23

Division Sessions

Construction Division

9:30 A.M. SOUTH AMERICAN ROOM A

Presiding: Ross White, M. ASCE; Member, Executive Committee, Construction Division

9:30 **Construction with Sliding Forms**

James W. MacDonald, Jr., Jun. M. ASCE; Engineer, MacDonald Engineering Company, Chicago, Ill.

10:15 **Cableways—Their Construction and Use**

James Tripp, M. ASCE; Construction Consultant, New York, N.Y.

11:00 **Concrete Piles for the Morganza Floodway**

George Ferris, Vice-President and General Manager, Raymond Concrete Pile Co., New York, N.Y.

Highway Division

9:30 A.M. CRYSTAL BALLROOM

Presiding: G. Donald Kennedy, M. ASCE; Member, Executive Committee, Highway Division

9:30 **The Maryland Test Road**

Roy W. Crum, M. ASCE; Director, Highway Research Board, Washington, D.C.

10:00 **Discussion**

10:30 **Future Prospects for the U. S. Primary Highway System**

Dewitt C. Greer, M. ASCE; State Highway Engineer, Austin, Tex.

11:00 **Discussion**

11:30 **Open Discussion of Highway Problems**

Hydraulics Division

9:30 A.M. SOUTH AMERICAN ROOM 1

Presiding: George R. Schneider, Assoc. M. ASCE; Chairman, Executive Committee, Hydraulics Division

9:30 **Flow of Water in Commercially Smooth Pipes**

Fred C. Scobey, Vice-President, ASCE; Consulting Engineer, Berkeley, Calif.

Discussion

Waterways Division

9:30 A.M. SAM HOUSTON ROOM

Presiding: Max C. Tyler, M. ASCE, Chairman, Executive Committee, Waterways Division

9:30 **Construction and Maintenance of the Houston Ship Channel and Spoil Disposal Problems Involved**

Kenneth Heagy, M. ASCE, Engineer, Galveston District, Corps of Engineers.

10:30 **Considerations in the Development of a Flood Control Plan for Houston, Tex.**

E. I. Davis, Assoc. M. ASCE, Colonel, Corps of Engineers; District Engineer, Galveston District.

Luncheon

Friday, Feb. 23

12:30 P.M. EMPIRE ROOM
RICE HOTEL

All members, their ladies and guests, and friends of ASCE are cordially invited to attend. $2.25 per plate.

Friday Afternoon

Highway Division

2:00 P.M. CRYSTAL BALLROOM

Presiding: Ben H. Petty, M. ASCE; Chairman, Executive Committee, Highway Division

2:00 **Trends in Embankment Construction in Marsh Areas**

Robert B. Richardson, M. ASCE; Director of Highways, Baton Rouge, La.

2:30 **Discussion**

3:00 **The Houston Expressway System**

W. J. Van London, Engineer-Manager, Houston Urban Expressway Project, Houston, Tex.

3:30 **Discussion**

4:00 **The Problem of Capital Betterment of Existing Highways Versus Complete Reconstruction**

Burton G. Dwyre, M. ASCE; State Highway Engineer, Santa Fe, N. Mex.

4:30 **Discussion**

Power Division

2:00 P.M. SOUTH AMERICAN ROOM 1

2:00 **Water Problems in Connection With Steam Electric Generating Plants in Texas**

L. Elliott and M. G. Salzman, M. ASCE; Ebasco Services Incorporated, New York, N. Y.

2:45 **Engineering Aspects of Brazos River Hydroelectric Projects**

C. R. Marks, III, Assoc. M. ASCE; Chief Engineer, Ambursen Engineering Company, Houston, Tex.

3:30 **Pumped Storage Hydroelectric Plant on Colorado River, Texas**

G. E. Schmitt, Assistant Manager and Chief Engineer, Lower Colorado River Authority, Austin, Tex.

Power plant models will be exhibited at the convention headquarters by the Texas Electric Service Co.

A trip to the Greens Bayou Steam Electric Plant of the Houston Lighting and Power Co. on February 23 at 9:00 a.m.

Transportation will be provided from the headquarters hotel.

Sanitary Engineering Division

2:00 P.M. SOUTH AMERICAN ROOM A

Presiding: Frank W. Jones, M. ASCE; Secretary, Executive Committee, Sanitary Engineering Division

2:00 **Sanitary Engineering Aspects of Disaster Planning**

James S. Marsh, Assoc. M. ASCE; Commander, E.E.C., U.S.N.; Officer in Charge, Naval School for C.E.C. Officers, Port Hueneme, Calif.

2:30 **Recent Improvements in Houston's Sanitary Systems**

William E. White, Assoc. M. ASCE; Chief Design Engineer, Public Works Department, Houston, Tex.

3:00 **Houston's New North Side Sewage Disposal Plant**

John C. Turney, M. ASCE; Consulting Engineer, Houston, Tex.

Discussion:

Samuel A. Greeley, M. ASCE; Consulting Engineer, Chicago, Ill.

3:45 **Underground Corrosion of Piping**

Russell A. Brannon, Supervising Corrosion Engineer, Humble Pipe Line Company, Houston, Tex.

Discussion:

Walter F. Rogers, Chief Chemist, Houston Division Chemical Laboratory, Gulf Oil Corp., Houston, Tex.

Waterways Division

2:00 P.M. SAM HOUSTON ROOM

Presiding: Max C. Tyler, M. ASCE; Chairman, Executive Committee, Waterways Division

2:00 **Engineering Problems of a Navigation Channel to Victoria, Tex.**

A. B. Davis, Jr., Engineer, Galveston District, Corps of Engineers.

2:45 **Shale Foundation for Earth Dams**

Delbert B. Freeman, M. ASCE; Colonel, Corps of Engineers; District Engineer, Fort Worth District.

3:30 **Diversions of Water from Its Natural Courses**

F. N. Menefee, M. ASCE; Vice Chairman, Committee on Diversions, Professor of Engineering Mechanics, University of Michigan.

Local Sections Conference

9:30 a.m. Monday February 19
Tuesday February 20

RICE HOTEL

Representatives of Local Sections of ASCE in the South and Southeast area will convene in the Rice Hotel on the Monday and Tuesday preceding the convention.

The conference, which is primarily for appointed delegates of selected Sections, will be open to any and all who may be interested in the activities and operational details of ASCE Local Sections.

Ladies Entertainment

WEDNESDAY, February 21

a.m. **Address of welcome** and opening of the Houston Convention Crystal Ballroom, Rice Hotel

Coffee hour and reception by the Ladies Reception Committee

Noon **Membership luncheon**

p.m. **Buffet dinner at the Shamrock Hotel**

THURSDAY, FEBRUARY 22

a.m. **Coffee hour** and reception by the Ladies Reception Committee

Noon **Ladies luncheon** and style show—Emerald Room, Shamrock Hotel. Transportation will be provided.

p.m. **Dinner dance** in the Crystal Ballroom of the Rice Hotel.

FRIDAY, FEBRUARY 23

a.m. **Coffee at Joske's**

p.m. **Garden tour** and tea at the River Oaks Country Club.

Texas barbecue and entertainment at the Rice Stadium.

Transportation will be provided.

STUDENT CHAPTER CONFERENCE

Tuesday, February 20

CRYSTAL BALLROOM RICE HOTEL

Student registration opens 9:00 a.m., February 20. Registration fee $1.00

9:30 a.m. **Contest for Outstanding Papers**

12:30 p.m. **"Meet-the-Board" Luncheon**

2:30 p.m. **Forum of Chapter Operations**

7:30 p.m. **"Get-Acquainted" Smoker at the Shamrock Hotel**

Wednesday, February 20

2:00 p.m. **Tour of San Jacinto Tunnel under the Houston Ship Channel**
Transportation provided.

Throughout the days of the Houston ASCE Convention, students are cordially invited and encouraged to attend Technical Division sessions and any other Convention events.

Texas Style Barbecue and Entertainment

FRIDAY, FEBRUARY 23

6:00 P.M. RICE STADIUM

The huge new Rice Stadium will be opened for a spectacular evening complete with Texas-style barbecue served by costumed waitresses and waiters. A cowboy band will entertain.

Transportation by bus from the Rice Hotel to the stadium and return will be furnished.

And—the whole evening's gala outing will be without charge for all registered at the convention, with the compliments of the Texas Section, ASCE.

For Your Pleasure While Visiting Houston

BOAT TRIPS

Arrangements have been made to place at the disposal of the delegates privately owned motor boats and launches for trips on the Houston Ship Channel on the afternoons of Monday, Tuesday, Friday, and Saturday of convention week. One hundred delegates can be accommodated on each of four days. All who are desirous of making the trip are requested to indicate their wishes at the time of registration. Buses will be provided for transportation from the Rice Hotel to the Ship Channel and return.

CLUBS

Delegates desirous of enjoying the hospitality of the Houston Club, the Houston Country Club, the River Oaks Country Club, are requested to make their wishes known to any of the local Convention Committee so courtesy cards may be provided during their stay in the city.

GOLF

Houston has four country clubs, at any one of which arrangements can be made to extend the courtesies of the club to visiting golfers desirous of engaging in their favorite sport.

Hotel Accommodations

Make Hotel Reservations Early.

The Rice Hotel in downtown Houston is headquarters for the Houston Convention of ASCE. Most events, unless otherwise specifically noted, will be held in this hotel. All planning to attend the Houston Convention are urged to make requests for room reservations as early as possible.

To assure accommodations at the headquarters Hotel Rice, requests should be received by the hotel not later than February 1. Later applicants may have to be assigned to other hotels nearby.

Rates at the Rice start at $4.00 single and $6.00 double. Suites and special accommodations are available for early reservation.

Requests for reservations should be mailed to:

Mr. George B. Adams
Rice Hotel
Texas and Main
Houston, Texas

Requests should mention your attendance at the Houston Convention of ASCE. A special request form is printed on page 86 of this issue for your convenience.

Post Convention Tour to Mexico City

Immediately following the close of the Houston Convention, a tour to Mexico City has been arranged for the convenience of those planning a holiday "south of the border."

All reservations and further inquiries should be addressed to:

Mr. Charles R. Haile, Chairman
Committee on Transportation
2801 San Jacinto St.
Houston 4, Texas

Following is a brief schedule of the tour:

Friday, February 23—Leave Houston via Southern Pacific Lines at 11:40 p.m.

Saturday—Arrive San Antonio 6:15 a.m. Pullman cars set out until 8:00 a.m. An optional two-hour tour of San Antonio is suggested. Price $2.30. Leave San Antonio 12:05 p.m. via the Missouri Pacific and the National Railways of Mexico.

Sunday—En route. An all-day ride over the Grand Central Plateau, with short stops at San Luis Potosi, Queretaro and a number of interesting little towns along the way. Arrive Mexico City at 8:30 p.m. Private cars transfer party to one of the capital's new and thoroughly modern hotels, all rooms with bath.

Monday through Friday—Extensive sightseeing to include Mexico City, Cuernavaca, Tasco, Puebla, Cholula, the Pyramids and Xochimilco.

Saturday, March 3—Leave Mexico City at 8:00 a.m. We gradually descend from the Grand Central Plateau, making short stops en route.

Sunday—After quick and courteous Immigration and Customs inspections we cross the border early in the morning. Arrive San Antonio at 1:30 p.m. Convenient train connections for all points north, east and west back home.

All-Expense Tour Cost per Person from Houston to Mexico City and Return to San Antonio

Coach	One in Lower	One in Upper	Two in Lower
$120.98	$165.72	$159.41	$150.98

Two in Compartment	Two in Drawing Room	Three in Drawing Room
$177.44	$192.24	$173.58

What Is Included in the All-Expense Cost: Coach or first-class rail and Pullman tickets from Houston to Mexico City and return to San Antonio; 15% U. S. tax; tourist permits; transfer of passengers and their baggage from station to hotel and vice versa; first-class hotel in Mexico City and Tasco—two persons to a room with bath; sightseeing trips as outlined, in automobiles—four passengers to a car with English-speaking guides; all meals in Mexico City and outside of the city; overnight stay at hotel in Tasco.

Not Included in the All-Expense Cost: Meals on board the trains; bullfight; liquors; laundry; tips and expenses of personal nature.

Custom House and Health Formalities. A vaccination certificate is required. Returning home each traveler is allowed to bring in free of duty, $200.00 U. S. Cy. worth of Mexican articles and souvenirs.

Rate of Exchange. At present is about $8.65 Mexican Cy. for each $1.00 U. S. Cy.

Tipping. Advisable on same basis as at home: 10 percent of bill.

About the Language. A knowledge of Spanish is useful but not necessary. Nearly all people with whom the tourist comes in contact speak English.

Wardrobe. The trip to Mexico City implies no special requirements in wardrobe or luggage. Since the altitude there is high, a light coat may be found desirable occasionally in the morning or late evening.

Reservations and Deposits. A deposit of $25.00 is required. Final payment due on or before February 10. Checks should be made payable to Mr. L. D. Snow, Houston. In case of cancellation, full refund will be made.

For those preferring transportation by air to Mexico City, a similar tour is available, with details on request from Mr. Haile.

Houston Convention Committees

Robert J. Cummins, *General Chairman*
Raymond F. Dawson, *President, Texas Section*
Lowber D. Snow, *Past-President, Texas Section*

Entertainment Committee
Russell L. Jolley, Chairman

Finance Committee
Warren S. Bellows, Chairman

Hotel and Arrangements Committee
George H. Lacy, Chairman

Ladies Committee
Mrs. Robert J. Cummins, Chairman

Publicity Committee
Howard T. Tellepsen, Chairman

Reception Committee
Frank H. Newnam, Jr., Chairman

Registration Committee
Raymond R. Sartain, Chairman

Student Activities Committee
Oscar H. Koch, Dallas, Chairman

Technical Committee
Mason G. Lockwood, Chairman

Transportation Committee
Charles R. Haile, Chairman

SOCIETY NEWS

EJC Manpower Commission Recommends Separate Registration by Selective Service

In the belief that military and industrial (civil) requirements for engineering personnel are equally important in the national defense program, the Engineering Manpower Commission of Engineers Joint Council has recommended registration by Selective Service of every man up to age 70 who is enrolled for training in, is training for, or is working in one of the critical fields of engineering.

The Commission stated that the purpose of the registration was "to locate all engineering skills so that they can be appraised and made available as needed by industry and the military. Registrants covered by Selective Service regulations or Reserve component rules should be reviewed for possible inclusion and earmarking as a reserve."

In making its report, dated December 20, which was prepared at the request of the Manpower Office of the National Security Resources Board, the twenty-man EJC Commission, on which the American Society for Engineering Education is also represented, emphasized the expected cumulative shortage of over 40,000 engineering graduates by 1954 (see article by S. C. Hollister in this issue), and suggested that all-year operation of engineering colleges may be required to shorten the educational period. Deferment of induction of students with satisfactory records, as well as of the necessary faculty, is also recommended.

"For the most effective utilization of engineers in the national effort," the Commission recommends the establishment of a National Engineering Personnel Board whose duties "shall be to review registrations, to establish criteria for inclusion in a 'Reserve,' to classify the registrants, and to make selections of persons with critical skills for military, civil defense, and industrial allocation." The Board would administer the Reserve and allocate the registrants, with the help of regional boards appointed as directed.

Recognizing the universal obligation of the entire citizenry for service in some essential form, the Commission reviewed the Conant Plan for universal military training. In the opinion of the Commission, any such plan must be modified to recognize "(1) The fundamental policy of continuing training of qualified scientific, technical, and engineering personnel, needed in the years ahead, in the interest of national security, health and welfare, and (2) the fundamental policy of providing for both the military and industrial needs for scientific, technical, and engineering personnel."

The Commission emphasized that a "fundamental and essential condition of any program of defense depends on realization that the survival of the United States as a free democracy in the worldwide struggle for control will depend on superior and prior scientific and engineering skills to offset superiority of numbers which the free nations lack." Inequality of manpower, numerically, the Commission stressed, must be overcome by quality of manpower technically. Superiority of morale is not sufficient.

The Commission further recommended that suitable legislation be provided in the ROTC program, so that the training of scientific, technical and engineering personnel needed by industry will be continued as well as that for personnel in uniform.

The EJC Commission also reviewed the proposal of the Six Scientific Advisory Committees to Selective Service and expressed its support of the procedures recommended. Those procedures are reported in the "News Briefs" section of this issue.

EJC Objectives and Activities Reviewed

A pamphlet describing the organization, objectives, and activities of Engineers Joint Council was recently sent out from the Secretary's Office to Society and Local Section officers, and committee and Technical Division personnel. For the convenience of members who have not had an opportunity to see this summary of the important role of EJC in professional development, the pamphlet is summarized here.

A federation of the national engineering societies representing the five basic branches of the profession, EJC is made up of elected officers directly representing over 115,000 engineers of every specialty and occupational status. Component groups are the four Founder Societies and the American Institute of Chemical Engineers.

Every individual member of any one of these societies is represented on Council by two past-presidents, the secretary and an alternate of his own organization. This means that ten of the fifteen delegates on EJC have been elected to the presidency of their respective societies. The five secretaries, of course, are appointed by their respective governing bodies. Thus, the elected and appointed officers most closely acquainted with current interests of their constituents serve to coordinate efforts of the profession as unified by EJC. Similarly, the means is provided for anyone of the 115,000 members of the EJC Societies to bring his views to the federation forum for discussion and action.

Objectives Defined

The EJC Constitution specifically defines its objectives as follows:

"1. To advance the general welfare of mankind through the available resources and creative ability of the engineering profession.

"2. To promote cooperation among the various branches of the engineering profession.

"3. To develop sound public policies respecting national and international affairs, wherein the engineering profession can be helpful through the services of the members of the engineering profession."

To reach these objectives, EJC carries on activities within a framework of committees appointed from the membership of the component societies. As occasion may demand on special problems, committee members from other than the EJC societies are added. Criteria for determining participation in any activity are (1) that it shall be of wide interest to the profession, and (2) that it shall be a matter having a direct impact on the profession, or one regarding which it is believed that action by the profession can contribute to the public interest.

Present Specific Programs

Current projects include the following:

1. General Survey Committee compiles data and reports to the profession on such matters of universal concern as de-

mand for, and supply of, engineering personnel, salary scales and classification schedules. Typical reports of such surveys are "Employment Programs for Engineering Graduates" and "The Engineering Profession in Transition," which have been published.

2. Committee on Increased Unity in the Engineering Profession has brought together representatives of 16 engineering societies to study ways and means for advancing cooperation among the numerous organizations of the profession.

3. Labor Legislation Panel maintains continuous watch on developing legislation that affects the professional status of engineers. It has frequently presented testimony before Senate and House Committees upon invitation of those committees.

4. Science Legislation Panel has continuously supported the inclusion of engineering and engineering research in any "science foundation bill" under Congressional consideration. It has frequently presented testimony, on invitation, to Congressional Committees.

5. Committee of Engineers Cooperating in Medical Research was established to explore engineering and scientific assistance to the medical researcher. A second activity of this committee is the transfer of such experience to a broad cross section of engineers through the publications of the constituent EJC societies.

6. Committee of Engineers in Civil Service has established an "Engineers' Advisory Committee" to the U. S. Civil Service Commission, to protect the interests of the thousands of engineers in public employ and to assist the Commission.

7. Committee on National Water Policy has produced (June 1950) a monumental statement giving an analysis and recommendations on this nationally vital subject.

8. Committee on Selected Engineering Personnel is serving in an advisory capacity to the National Security Resources Board on problems related to highest utilization of services of engineers in times of national emergency.

9. National Engineers Committee accepts leadership in national and international affairs where the engineering profession has direct interest. "Task Committees" have undertaken such assignments as advising ECA on matters of engineering personnel, compilation of the Research and Development (ONR) Personnel Survey, classification of engineering specialties in the military establishment, obtaining in army reorganization legislation provisions to protect the professional status of engineers and scientists.

10. Committee on International Relations has arranged for participation of U.S. engineers in international engineering meetings, assisted foreign engineers visiting the U.S. and assisted engineering libraries abroad.

11. UNESCO representation is maintained by an EJC delegate on the U.S. National Commission.

Financing Operations of EJC

Activities of EJC are financed by contributions from the constituent societies in proportion to their income from dues. Required funds are set up annually in a budget subject to approval by all. Total operating expenses during 1949 were under $4,000, or less than 3.5 cents per member represented on the Council. This remarkably low unit cost is one of the greatest advantages of such a federation of societies. Significant accomplishments without large expenditures are possible because the work is carried on voluntarily by the outstanding leaders of the profession, and because the costly duplication of membership records, services and publications is avoided.

Headquarters of EJC

The secretaryship of EJC rotates annually among the secretaries of the component societies. The address of permanent headquarters maintained in the Engineering Societies Building in New York City is Engineers Joint Council, 29 West 39th Street, New York 18, N.Y.

Daniel W. Mead Prizes Awarded for Essays on Ethics

This year's awards of the Daniel W. Mead Prizes for the best essays on a subject involving professional ethics go to two veterans—Roy G. Cappel, Jun. M. ASCE, winner in the Junior category, and Gordon L. Laverty, Jun. M. ASCE, who receives the Student Chapter award for a paper written while he was a member of the Society's Student Chapter at the University of California. Both wrote on the subject, "The Junior Engineer's Idea of His Employer's Ethical Responsibility to Him."

Roy G. Cappel

Gordon L. Laverty

In the Combat Engineers in World War II, Mr. Cappel saw front-line duty with the British Second Army and, after V.E. Day, occupation duty with the U.S. Eighth Army. Upon his return to the United States, he reentered Louisiana State University, where he received a B.S. degree in civil engineering in June 1948. Since then he has been employed by the W. Horace Williams Co., Inc., engineers and contractors of New Orleans. His work has included the design and supervision of construction of heavy engineering and harbor structures and of offshore platforms in the Gulf of Mexico, built to facilitate oil-field exploration. Presentation of his award will be made at the ASCE Winter Convention in Houston.

Mr. Laverty's education at the University of California was interrupted by a three-year period of Army service in World War II—part of it with the Army Signal Corps in New Guinea, the Philippines, and Japan. In 1946 he reentered the University of California at Berkeley to continue his studies in sanitary engineering, graduating with a B.S. degree in civil engineering in February 1950. Mr. Laverty is now employed as a sanitary engineer in the Sanitary and Pumping Section of the East Bay Municipal Utility District at Oakland. He will receive his award at an early meeting of the San Francisco Section.

Alfred Noble Prize Goes to Electrical Engineer

R. J. Kochenburger

Ralph J. Kochenburger, an electrical engineer and associate member of the AIEE, has been awarded the Alfred Noble Prize for 1950 for a paper on, "A Frequency-Response Method for Analyzing and Synthesizing Contactor Servomechanisms." A joint award of the four Founder Societies and the Western Society of Engineers, the Alfred Noble Prize consists of a cash award of $350 and a certificate. It is awarded annually to a young member of one of the sponsoring societies for a published technical paper of unusual merit.

Mr. Kochenburger was born in Jersey City, N.J. He graduated from the Massachusetts Institute of Technology in 1940 with the degree of S.B. in electrical engineering, receiving his S.M. from the same institution in 1941. He was with the Curtiss Propeller Division as research engineer from 1941 to 1946 and in the latter year returned to M.I.T. as a research associate, obtaining his Sc.D. in electrical engineering in 1949. His thesis research work on contactor servomechanisms was performed as part of a U.S. Air Forces project.

Becoming assistant professor of electrical engineering at the University of Connecticut in 1950, Mr. Kochenburger is currently engaged in organizing graduate courses in servomechanisms and related fields and in the establishment of a new research laboratory there. He is consultant on controls for the M. W. Kellogg Co., of Jersey City, N.J.

Karl T. Compton of M.I.T. Is Awarded Hoover Medal

Award of the 1950 Hoover Medal to Dr. Karl T. Compton, chairman of the Corporation of the Massachusetts Institute of Technology, for "distinguished public service," is announced by Scott Turner, chairman of an award board representing the four Founder Societies. The medal will be presented during a general session on the first day of the winter general meeting of the AIEE, to be held in New York City, January 22-26.

The twelfth engineer to receive the Hoover Medal since it was first awarded to Herbert Hoover in 1930 to commemorate his civic and humanitarian achievements, Dr. Compton is cited as a "Great leader in engineering education, who has had a profound influence on the development of science and engineering, and has devoted himself wholeheartedly to the welfare of the nation, both in times of peace and times of war. . ."

A native of Wooster, Ohio, and a graduate of Wooster College, Dr. Compton taught there and at Reed College before going to Princeton in 1915. He was research professor and chairman of the physics department when he left in 1930 to become president of M.I.T. He was named chairman of the Corporation of M.I.T. and chairman of the Research and Development Board of the National Military Establishment in 1948. He retired recently from the latter post because of ill health. During World War I, Dr. Compton was an aeronautical engineer in the Signal Corps and later an officer in the Research Information Service and Associate Scientific Attache to the American Embassy in Paris. During the recent war he was chairman of many wartime committees and boards.

GAIL A. HATHAWAY, President-elect of ASCE and special assistant to Chief of Engineers, Office of the Chief of Engineers, Washington, D. C., heads United States delegation to forthcoming international engineering conferences, to be held in Bombay and New Delhi, India, during January. Other ASCE member in delegation are Directors Waldo Bowman and Francis S. Friel, L. F. Harza, C. E. Blee, J. H. Douma, P. T. Bennett, W. C. Cassidy, L. E. Rydell, L. N. McClellan, and F. L. Adams.

JOHN C. REHFIELD, Jun. M. ASCE, becomes assistant editor of ASCE Technical Publications, New York, N.Y. Graduate of City College of New York and Harvard University and a professional engineer, Mr. Rehfield was formerly associated with Malcolm Pirnie Engineers. He served as construction supervisor with an engineer battalion during World War II.

Rutgers University Is Host to Student Conference

Accomplishments and objectives of the ASCE Student Chapter program were detailed by Prof. William S. LaLonde, Jr., at an all-day and evening meeting at Rutgers University on December 16. Professor LaLonde, president of the Metropolitan Section of the Society and head of the Department of Civil Engineering at Newark College of Engineering, cited the development of a "professional attitude" and association with practicing engineers as prime objectives of Chapter organization. The necessity of broadening the education of civil engineers was also emphasized by Dean Elmer C. Easton, of Rutgers, in his welcoming address. The Dean compared the educational objectives of universities and professional societies.

An address entitled "The Romance of Bridges" was presented by D. B. Steinman, New York City consultant. His talk and slides traced the development of the various types of bridges from humble crossings to recent monumental structures.

Inspection tours, reports of Chapter delegates, a luncheon, dinner, and dance were additional features of the conference, which was planned under the direction of Alex A. Slavin, conference chairman. Over 100 delegates from seven Chapters in the New York City area were present.

Committee on Timber Structures Is Enlarged

Addition of six new members to the ASCE Structural Division's Committee on Timber Structures is announced by H. J. Hansen, chairman of the Control Group of the committee. They are B. Benioff and Harry W. Bolin, of Los Angeles; Charles A. Chaney, of Chevy Chase, Md.; Alan Freas, of Madison, Wis.; and C. B. Lund and E. J. Ruble, of Chicago.

Revision of ASCE Manual No. 17, *Timber Piles and Construction Timbers*, is being undertaken by the Committee on Timber Structures. The work of revision is headed by William A. Oliver, professor of civil engineering at the University of Illinois and chairman of the revision committee. A draft is expected at the end of 1951.

Engineering Vocational Guide Reprinted by ASCE

The Society's "Brief Bibliography on Engineering as a Career" has been reprinted with a few additional references and is available without charge to those interested. This two-page publication has been popular with schools, libraries, and guidance counsellors since its inauguration in 1935. It will be found useful by engineers and teachers in directing students to informative books on engineering as a career.

Requests for copies should be sent to the Executive Secretary, ASCE, 33 West 39th Street, New York 18, N.Y.

FROM THE NATION'S *Capital*

JOSEPH H. EHLERS, M. ASCE
Field Representative, ASCE

With the declaration of a National Emergency by President Truman, the country enters a new and greatly intensified stage of the defense mobilization program. The emergencies declared in 1939–1941 are still in effect. The new proclamation adds a few powers such as permitting bids to be taken without advertising, but in general it is important principally for its vast psychological effect. The President also requested Congress to revive Titles 1 and 2 of the War Powers Act of 1941. This would permit him to coordinate and transfer government agencies and modify government contracting procedure.

Construction Controls Expand

With the appointment of Charles E. Wilson, General Electric President, as head of a new agency, the Office of Defense Mobilization, the controls are entering a new phase. Currently we are operating under a system in which four major agencies—Defense, Atomic Energy, Coast Guard, and the National Advisory Committee for Aeronautics—have authority to issue direct priorities for defense needs (D.O. ratings). No other priority powers are in effect. A free market exists except for certain conservation and prohibition orders issued by the National Production Authority, which place limitations on some materials and types of construction.

The ground work for rigidly controlled production was laid by the designation of "claimant" agencies for materials. Four basic claimant agencies were designated by order of the President in September: Interior, Agriculture, Commerce, and the ICC (October, Civil Engineering, page 53). These agencies have the right to redelegate; the Secretary of Commerce by departmental order in November made such redelegations. Claimant agencies now designated, which are of specific interest to Society members, include the following: the Commissioner of Public Roads, for all highway construction and maintenance including streets, regardless of whether federal aid is involved; the Veterans Administrator for certain veterans' hospitals; Secretary of the Army for civil works; the Federal Security Administrator for schools, certain hospitals and supplies for education and recreation; the General Services Administrator for other federal building construction and federal supplies; and the Housing and Home Finance Administrator for all housing construction and for local community facilities, including sewerage and water works. An NPA official is designated claimant for businesses not otherwise designated. Details of the claimant agencies' designations may be found in Commerce Department Order No. 127 of November 24.

In any controlled materials plan, these claimant agencies would play a key role in allocating materials. We may look for some controlled materials plan when the necessary organization is built up to administer it. Pending the establishment of some such plan, more limiting orders by NPA may be expected. A prohibition order affecting the use of copper in builders hardware and for construction uses may be expected soon. A comparable order on aluminum products is also expected. Likewise, soon after the first of the year, a restrictive order applying to some types of commercial buildings may be considered as possible.

Military Construction Mounts

The House has passed an appropriation of about $18 billion for defense, bringing the total to about $42 billion for the current fiscal year. Army construction of $320 million, Air Force, $807 million, Navy, $303 million, and Atomic Energy, $860 million is provided for. The Senate Appropriations Committee has passed a similar bill totaling $20 billion. This appropriation will undoubtedly become law before Christmas. A bill (H.R. 9893) authorizing $1.6 billion for military construction and public works has passed both houses. This puts the country into a military preparedness program of vast proportions. It is obviously warranted by the precariousness of our footholds on the fringes of the great European-Asiatic continent. Regardless of whether we can reinforce these footholds or whether we must prepare for a possible contest of sea and air power versus land power, a maximum military and industrial preparedness program now necessarily confronts us.

Senate Considers Matching Civil Defense Funds

A bill providing for a program of civil defense has passed the House and is being considered in the Senate. Provision is made for federal contributions to be matched by state funds, for a combined expenditure of $3 billion. Operations would rest with state and local authorities. A twelve-man advisory council is provided for, six members of which would represent state and local governments. Federal contributions for protective facilities would be in the proportion that the urban population of the critical target areas of a state bears to the urban population of all U. S. critical target areas. Provision is made for mutual assistance agreements between states. By executive order the President has set up a Civil Defense Administration removing jurisdiction over civil defense matters from the National Security Resources Board. Former Governor Milliard Caldwell of Florida, an outstanding administrator, was persuaded to accept the post of administrator. A joint meeting to study the coordination of our civil defense with that of Canada was recently held. Pamphlets dealing with the fire effects of bombing attacks, specifications for monitoring instruments, and a code of warning signals have been issued. This work will offer an exceptional opportunity for participation by local ASCE Sections.

Water Policy Commission Reports

As amplified elsewhere in this issue, the report of the President's Water Policy Commission has been issued. The Commission will meet in January to formulate specific legislative proposals. The Commission's recommendation that projects for which no appropriations have been made be frozen until a basic policy has been formulated, except where they have defense value, fits in admirably with the existing emergency situation, and this should permit a resumption of action on such projects under a clarified policy.

At a meeting of the ASCE-AGC Joint Committee held in Washington, December 18, many topics of mutual interest were discussed, including contract forms, manpower problems, suggestions for committees advisory to the production controls establishment, and other agencies. This joint committee may serve as a clearing house for an exchange of views so that action by ASCE may be taken with a knowledge of the AGC views on any subject.

The Field Representative has also attended recent meetings to discuss a division of responsibilities among the design professions and overall construction industry meetings to discuss proposed new NPA control orders.

D. C. Registration Board Named

The Commissioners of the District of Columbia have named a five-man Board of Engineers to administer the new law requiring the licensing of all practicing engineers in the District. Daniel C. Walser, M. ASCE, was named the civil engineering member for the maximum five-year term; Leo H. Cleary, the electrical engineering member for a four-year term; and M. X. Wilberding, M. ASCE, the mechanical engineering member for a three-year term. M. T. Bennett represents the chemical engineering field, and L. D. Purnell is the fifth member representing unclassified engineering categories. Regulations concerning application procedure will probably be available sometime in January.

Dr. James Conant, president of Harvard, was elected chairman of the National Science Board of the newly established National Science Foundation. The Board will meet again in January to nominate an executive director for the Foundation, the appointment being made by the president.

Dr. H. G. Bennett, president of the Oklahoma A & M College, has been named director of the Point IV Program. He has recently made agricultural surveys for the Army and the Ethiopian government. An important venture under the Point IV Program is a rural-improvement program in Iran.

With the stepping up of defense and other construction activities in Alaska, there will be a need for engineers. The Alaska Public Works Division of the Office of Territories, Interior Department, has openings for a few engineers to review applications, plans and specifications for sewer and water projects, mechanical and electrical work in connection with institutional buildings. These jobs will pay about $8,000 per year for service in Juneau.

A $250 million public housing proposal will be incorporated in a defense housing bill to be introduced in Congress early in the 82nd session.

Washington, D.C.
December 21, 1950

Active Program Initiated by New Maine Section

An ambitious program of luncheon meetings covering various areas of the recently formed Maine Section of ASCE is announced. Recent programs presented at meetings in the Augusta area, the Portland area, and the Bangor-Orono area have been devoted to discussion of Society affairs, to technical talks, and to moving pictures on technical subjects. About 55 members of the ASCE Student Chapter at the University of Maine attended the Orono meeting, which was held on the university campus. Other activities include participation in a two-day state Highway Conference at Orono on December 15 and 16 and aid in arranging a proposed conference on "Engineering Planning and Programming for Maine Towns and Cities," to be held at the university during the winter.

Since its formation in August, the Section has issued a monthly "News Letter," devoted to keeping members abreast of Society and Section activities and matters of local professional interest.

TWO TOP SOCIETY OFFICERS AND VETERAN MEMBER arrive in Honolulu as guests of Hawaii Section. Greeted here with traditional leis are (left to right) ASCE senior Vice-President Henry J. Sherman, Mrs. Charles E. Smith, President Howard, Mrs. Howard, and Mr. Smith, life member of Society and retired vice-president of New York, New Haven & Hartford Railroad. Visitors were met by Hawaii Section officials headed by President L. H. Herschler, Secretary Robert M. Belt, and Vice-President B. J. McMorrow. Mr. Howard and Mr. Sherman were guests of University of Hawaii, where they investigated university curriculum and standards, with view to establishing Student Chapter there. In talk before Section, Mr. Howard deplored the United States' poor record of assigning workers to wartime duties. "Only about one-third of the men in World War II," he said, "were used in anything they could do well and were trained for." To overcome this problem, Mr. Howard stated, American engineering societies are working with the armed forces to place engineers to the nation's best advantage in event of war.

Columbia Section of ASCE Begins Operation

Full Section status was given the former Columbia Branch of the Spokane Section by the Board of Direction at its Chicago Meeting. The 72nd Local Section of the Society, the new Columbia Section includes Columbia, Walla Walla, Franklin, Benton, Yakima, and Klickitat counties in Washington and Morrow and Umatilla counties in Oregon. Most of the 112 Section members are employed at the Richland plant of the AEC or in the Corps of Engineers offices at McNary Dam or the Walla Walla Air Base.

At the first meeting under full Section status, Rear Admiral Ralph E. Davison spoke on world power relationships, with particular regard to United States-Russian relationships. Election of officers for 1951 resulted as follows: F. A. Torkelson, president; G. C. Aug, vice-president; and M. B. Nelson, secretary-treasurer.

COLUMBIA SECTION GROUP attending recent inaugural meeting includes (front row, left to right) George C. Aug, newly elected vice-president; B. L. Smith, director of Section; Rear Admiral Davison; President F. A. Torkelson; and O. H. Pilkey, director. In second row are D. S. Brumley, former vice-president; J. E. Travis, former president and director; M. B. Nelson, 1951 secretary-treasurer; and Directors Elmo Sims and J. R. Thatcher.

Local Section Coming Events

Central Ohio—Meeting at the Chittenden Hotel, Columbus, January 18, at 6:15 p.m.

Florida—Meeting of the Gainesville Sub-Section in Gainesville on January 25.

Georgia—Luncheon meeting at the Atlanta Y.M.C.A., the first Friday of each month, at 12:30 p.m.

Illinois—Weekly luncheons every Friday at the Chicago Engineers Club, at 12 noon.

Intermountain—Meeting in Salt Lake City on January 19.

Kansas—Meeting in Topeka, January 19, at 6:30 p.m.

Kansas City—Meeting in Kansas City on January 16.

Los Angeles—Meeting at the University of Southern California, Los Angeles, January 10.

Maryland—Meeting at the Engineers Club of Baltimore, Baltimore, January 10, at 8 p.m., preceded by cocktails at 6:15 p.m. and dinner at 7 p.m.

Metropolitan—Meeting in the Engineering Societies Building, New York City, January 17.

Miami—Meeting in Miami the first Thursday of each month.

North Carolina—Annual meeting at Duke University, Durham, on January 13.

Northeastern—Annual meeting in Boston, Mass., on January 22.

Northwestern—Meeting in Minneapolis the first Monday of each month.

Oklahoma—Dinner meeting of the Oklahoma City Branch in the Y.W.C.A. Building, Oklahoma City, January 19, at 7:30 p.m. Meeting of the Tulsa Branch in the Chamber of Commerce Building, Tulsa, the first Monday of each month.

Philadelphia—Meeting at the Engineers Club on January 9. Meeting of the Delaware Sub-Section on January 16.

Pittsburgh—Annual meeting in Pittsburgh on January 25.

South Carolina—Annual meeting at the Columbia Hotel, Columbia, January 19, at 10 a.m.

Spokane—Meeting of Columbia Branch in Richland, Wash., on January 11.

Syracuse—Meeting in Syracuse on January 22.

Tennessee Valley—Dinner meeting of Knoxville Sub-Section at the S & W Cafeteria, Knoxville, January 10, at 6:15 p.m.

Scheduled ASCE Conventions

WINTER CONVENTION
Houston, Tex., February 21–23
(Board of Direction meets February 19–20)

SUMMER CONVENTION
Louisville, Ky., June 13–15
(Board of Direction meets June 11–12)

ANNUAL CONVENTION
New York, N.Y., October 22–25

MISSISSIPPI STATE COLLEGE Student Chapter members inspect Mississippi River Commission's project at Burke Landing near Clarksdale. During all-day tour, sponsored by Commission, bank grading operations and concrete revetment laying were witnessed.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Akron	Nov. 21	17	Dinner meeting. Francis W. Stafford, president of Section, led discussion on contract specifications.
Buffalo	Nov. 17	46	George F. Flay, Jr., chief engineer and general manager of Drilled-In Caisson Corp., New York City, spoke on "Foundations."
Central Illinois	Nov. 7	45	Dinner meeting featuring Arthur N. Ekstrand, financial consultant, as speaker.
Central Ohio	Dec. 7	27	Annual meeting with installation of new officers. Prof. Kenneth W. Cosens, of Ohio State University, described his trip through the Rocky Mountains.
Cincinnati	Nov. 1	35	C. C. Singleton, regional structural engineer, Portland Cement Association, Philadelphia, Pa., presented an illustrated talk on prestressed concrete structures.
Colorado	Nov. 13	35	Dinner meeting with Arnold Condron, chief, Design Section, Denver Engineer's office, and Dewey Wright, deputy city engineer, Denver, speaking on the 17th Street paving.
District of Columbia	Nov. 14	140	Annual meeting. ASCE Director Frank Weaver reported on Society activities. Installation of new officers.
Florida Gainesville Sub-Section	Nov. 30	30	The development of the St. Lawrence Waterway was outlined by Harland Woods, retired Corps of Engineers officer, of Orlando, Fla. Election of officers.
Georgia	Nov. 3	45	George Sowers, professor of civil engineering, Georgia Institute of Technology, spoke on "Modern Techniques for Underground Exploration."
Illinois	Nov. 14	...	Joint meeting with Illinois Society of Professional Engineers. ASCE Past-President R. E. Dougherty spoke on "Unification, the Engineers Joint Council Plan."
	Dec. 15	...	Annual meeting with election of officers.
Indiana	Dec. 8	55	Annual meeting with business and technical sessions, installation of officers, and discussion on prestressed concrete by Henry B. Steeg, Indianapolis, Ind., consultant.
Iowa	Nov. 16	...	Afternoon and evening meeting. Program included talks by Student Chapter presidents from Iowa State College and Iowa University; report on section affairs by L. O. Stewart, secretary; discussion of recent Society activities by Director George Lamb; and election of officers.
Kansas	Nov. 17	...	ASCE President Ernest E. Howard discussed the NSRB plan for utilization of engineering personnel.
Kansas City	Nov. 7	140	ASCE Director Kirby Smith, with Raymond Concrete Pile Co., New York City, presented an illustrated speech on "Design and Installation of Pile Foundations."

	Dec. 5	71	Dinner meeting. Lee Reeder, Kansas City attorney, talked on "Facts vs. Fiction." Annual business meeting followed.
Kentucky	Nov. 17	65	Annual meeting. ASCE Vice-President D. V. Terrell reported on recent Chicago Meeting. Election of officers. Functions of the Agricultural and Industrial Development Board were described by Phil L. Miles, chief of the Maps and Minerals Division of the board.
Maryland	Nov. 8	135	Dinner meeting featuring Harry T. Immerman, chief engineer, Spencer, White & Prentis, New York, N.Y., as speaker.
Miami	Nov. 2	26	ASCE Director Edmund Friedman reported on Society's Chicago Meeting. "What I Saw in Europe" was discussed by Dade County Commissioner I. D. MacVicar.
Mid-South Jackson Branch	Nov. 29	14	Dinner meeting. M. B. Swayze, general manager, Mississippi Economic Council, spoke on council activities.
Vicksburg Branch	Nov. 20	...	Frank Everett, Vicksburg attorney, described professional organization of lawyers.
Montana Great Falls Branch	Nov. 2	30	Designing problems and construction operations of the Tenth Avenue South Bridge over the Missouri River were outlined by Paul Poirer, assistant project engineer, Montana Highway Department, and Robert W. Millensifer, member of Anderson Construction Co.
New Mexico	Oct. 27	64	Joint meeting with University of New Mexico Student Chapter. Speakers included ASCE Director Burton G. Dwyre and E. J. Workman.
Northwestern	Nov. 6	55	Meeting sponsored by Soil Mechanics and Foundation Committee with Hibbert Hill, hydraulic engineer, Northern States Power Co., Minneapolis, Minn., speaking on the Red River Valley.
Oklahoma Tulsa Branch	Nov. 6	43	Inspection tour of new improvements being installed at Tulsa's north side sewage disposal plant.
Philadelphia	Dec. 12	...	Joint meeting with ASME. Economics of power supply was discussed by J. H. Harlow and R. P. Liversidge, mechanical engineer and assistant manager of electric operations of Philadelphia Electric Co., respectively.
Pittsburgh	Dec. 7	...	Joint meeting with civil section of Engineers' Society of Western Pennsylvania. Professors Elio D'Appolonia and Charles F. Peck, of Carnegie Institute of Technology, spoke on design and construction of earth dams at Salem, Ohio.
	Dec. 13	...	Meeting of Section's Juniors. "Engineering Aspects of the Aluminum Company of America Building" was the subject of an address by E. C. Collins, construction superintendent for the organization. Election of officers.
Sacramento	Nov. 21	50	Luncheon meeting with Commander Marsh, Officer-in-Charge, CEC Officers' School, Construction Battalion Center, Port Hueneme, Calif., speaking on "Disaster Control."
Seattle	Nov. 29	93	Samuel Neff, resident engineer, Corps of Engineers, McNary Dam, Wash., presented a talk on diversion difficulties of the project.
Tacoma	Nov. 14	62	"The Deschutes Basin Project" was reviewed by V. R. Rathburn, resident engineer at Tacoma, Wash.
Toledo	Nov. 30	24	Jack Singleton, chief engineer, AISC, New York, N.Y., talked on steel construction.
Tri-City	Nov. 29	50	Annual meeting with business and technical sessions. Lt. Col. J. F. Arfman, assistant professor of military science and tactics, State University of Iowa, presented an illustrated talk on "Military Bridges, U.S. Army." Master Sergeants G. W. Chalfont and N. I. Russell participated in discussion.

"Transactions" for 1950 Is Issued by Society

Wide coverage is given civil engineering subjects in the currently available Volume 115 of TRANSACTIONS (for 1950), which contains 56 papers and the full text of Ernest E. Howard's Presidential Address, "The Society and the Profession," given at the ASCE Summer Convention in Toronto. Discussions have been assembled at the end of each paper (some of them appearing for the first time), and the whole body of text matter is classified in author and subject indexes.

Each member of the Society is entitled to receive one volume of TRANSACTIONS at the special standing order rate for each year he has paid dues. Approximately 40 percent of the membership have taken advantage of this opportunity. A member may also obtain other available volumes on a single-order basis, but only one volume for each year he has paid dues. Special rates for such standing or single orders are:

Leather binding..........	$4.00
Cloth binding............	3.00
Paper binding............	2.00

A member desiring to purchase additional volumes for any year in which he has paid dues, or volumes for any year prior to his enrollment as a member, may do so at the regular member subscription rate of $16 per volume (paper covered), less 50 percent discount, plus regular binding charges of $2 for leather and $1 for cloth. The rate for non-members is $16 a volume plus the same binding charges.

Mailing of standing orders for Vol. 115 has been completed. A reasonable stock of this and most other recent volumes of Transactions is on hand for general distribution.

Mohawk-Hudson Section Announces Student Prizes

The Mohawk-Hudson Section of the Society will award prizes of $25, $15, and $10 to the three best undergraduate papers to be presented at a joint meeting of Student Chapters of Rensselaer Polytechnic Institute and Union College on March 22, 1951.

Papers should be on topics pertinent to the field of civil engineering and should not be in excess of 5,000 words. They may set forth an original idea of the student or describe an engineering project with which the student is not connected.

Address inquiries to the president of the Section, Ralph G. Champagne, City Engineer, Troy, N.Y.

NEWS BRIEFS

Western Floods Damage Park and Highway Structures

Late in November record-breaking flood flows in most of the main streams draining the Sierra Nevada in California, from the Yuba River south to the Kern River, caused damage in excess of $30,000,000, according to Corps of Engineers estimates.

Park and highway damage in the Yosemite area is estimated at about $2,000,000. Although the major bridges held, numerous culverts and footbridges were washed away. Tourist courts and lodges near Yosemite received considerable damage, as rising waters buffeted cabins from their foundations and carried them away. Officials expect that all main roads will be open by next May, but that full restoration of side roads and trails will not be possible for over a year.

Floods on the Kings River destroyed the cofferdam at Pine Flat Dam, which is under construction by the Corps of Engineers. The American River, with a flood crest of 45.75 ft at Sacramento, also inundated sections of the suburbs, though the entire city is protected by levees. Evacuations were more numerous in unincorporated areas south of Marysville and southwest of Stockton, but generally there was no flooding of California cities.

Excessive rains on the eastern side of the Sierras caused unprecedented flooding of the Truckee River in Nevada. The estimated damage of $3,000,000 includes the loss of two old bridges in Reno. Major damage, however, was to merchandise stored in basements and to first-floor decor of hotels and stores. The Verdi powerhouse of the Sierra Pacific Power Co. went out because of a washed-out heading and is still out of service. This was the most serious hydro power loss.

Despite these floods in California and Nevada and excessive runoff in most of the Columbia River Basin, hydrologists in the U. S. Geological Survey report in the latest issue of the "Water Resources Review" that the runoff pattern in the West as a whole continues much the same as it has been for recent months. Runoff in the Colorado River Basin, it points out, is still generally deficient and at Grand Canyon was recorded at only 83 percent of normal. Despite flood conditions in northern California the drought in the southern part of the state continued with little change since November, and groundwater levels continued to decline in Cuyama Valley with the level in one well the lowest since the record began in 1941. In the opinion of some authorities, flood benefits to storage exceeded damage losses.

RAMPAGING MERCED RIVER between Mariposa and Yosemite National Park causes $600,000 damage to roadbeds along Highway 140 (Yosemite All-Year Highway). County, state, and local contractors pooled earthmoving equipment in fight to strengthen levees and washed-out roadways. Photo courtesy of Caterpillar Tractor Co.

Deferment of Superior Students Urged by Draft Advisory Board

A proposal for the indefinite deferment of superior university students from military service was advanced by a draft advisory group to the Selective Service System at a public meeting, attended by representatives of education, industry, labor, government, and other fields, in Washington, D.C., on December 18. Stressing its opinion that "highly trained specialized manpower could serve the national interest both in and out of the armed forces," the group recommended deferment of specially trained persons even after completion of their education, provided their skills can better be utilized elsewhere in the defense program.

Appointed two years ago by Maj. Gen. Lewis B. Hershey, Selective Service Director, to study the problem of classifying personnel "to the best interest of the national economy and the health, safety, and interest of the nation, the advisory group is made up of six committees representing agriculture, engineering, the healing arts, the humanities, and the physical and social sciences.

In presenting their joint report, the six advisory committees stated that their recommendations were governed by the provisions of existing legislation concerning the Selective Service System (Public Law 759) and were in accord with (1) "the declaration of Congress 'that adequate provision for national security requires maximum effort in the fields of scientific research and development, and the fullest possible utilization of the Nation's technological, scientific, and other critical manpower resources'; and (2) the effective carrying out of the responsibility imposed upon the Selective Service System by the same law which declares 'that an adequate armed strength must be achieved and maintained to insure the security of this nation.' "

The crux of the plan suggested by the advisory group is that students, to be eligible for draft postponement, must attain a score of at least 120 in a classification test similar to that given by the armed services and be certified as promising students. The plan also provides that students who are deferred to pursue courses have added to "their period of Selective Service liability a period equal to the time they were deferred for training. It was also recommended that Selective Service should create a classification to be known as II-A (S) "to cover all students who have demonstrated educational aptitude of potential value to the national health, safety, and interest."

Large Building Contract Awarded to Dallas Firm

Immediate construction of the new Republic National Bank Building in Dallas, to cost $17,500,000, and the award of what is said to be the largest single building contract in the history of the city, is announced by Fred F. Florence, president of the bank. The general construction contract has been awarded to the J. W. Bateson Co., of Dallas. Work is to start at once, with completion scheduled in about two years.

Designed by the New York City architectural firm of Harrison & Abramovitz, in association with Grayson Gill, M. ASCE, and George F. Harrell, of Dallas, the 36-story building will incorporate the most advanced design and construction features. A 160-ft tower will give the structure an overall height of 600 ft, making it the tallest building in the Southwest. It will be the first bank and office building in the country to include both garage and motor banking facilities.

Kansas City, Kans., Plans Improved Sanitary Facilities

An advance of $73,740 to assist Kansas City, Kans., in making an engineering study and report preliminary to the preparation of detailed plans and specifications for construction of sewage-collection and treatment facilities, has been approved by the Housing and Home Finance Agency. The first large-scale project to be approved for planning assistance since the establishment of new criteria governing construction of civilian public works in September, the Kansas City project will cost an estimated $6,231,500. It has been justified as an essential civilian requirement in that it is located in an important industrial defense area with major meat-packing, food-processing, and manufacturing plants within its limits.

The Kansas State Department of Health has ordered the city to correct its sanitary and storm-sewer system, which has been built over the past 75 years without provision for sewage treatment.

Defense Program Boosts Demand for Engineers

Employment opportunities for engineering graduates have improved greatly since the early part of the year, the Department of Labor states in a recent "Occupational Outlook Summary." Corroborating recent findings of such groups as the American Society for Engineering Education and the Engineers Council for Professional Development (CIVIL ENGINEERING for December, pages 51 and 52), the Department reports that the mobilization program has increased the demand for engineers to such an extent that employers are now seeking additional personnel, after absorbing the engineering schools' record 1950 graduating class of 50,000.

Hiring of engineers, it notes, has been much heavier this year than last, despite the fact that in January employers reported to Engineers Joint Council that their demands for engineering graduates would be down. The Department expects a still further increase in the demand for engineers in the coming months, and states that recent graduates who have entered non-engineering work can find opportunities for employment in their own field today.

Referring to its March 1950 summary of the occupational outlook, which was based on the assumption of peacetime conditions, the Department of Labor repeats that the engineering profession has been one of the fastest growing in the nation and predicts that it will probably remain so over the long run.

Huge Bus Terminal Called Aid Toward Solution of Metropolitan Traffic Problem at Dedication

Opening of the Port of New York Authority's $24,000,000 bus terminal, on December 14, was hailed by Mayor Vincent Impellitteri as "the greatest improvement yet made in the solution of New York's ever-increasing traffic problem." Addressing an audience of 2,000 at the dedication ceremonies, Mayor Impellitteri outlined his traffic program, which includes construction of a peripheral highway to route through traffic around the metropolitan area; revision of the city's antiquated dock system; and provision for side unloading of ships to relieve dock congestion. The cooperation of all civic groups and the public "is essential to the success of any over-all traffic-relief program," he stressed.

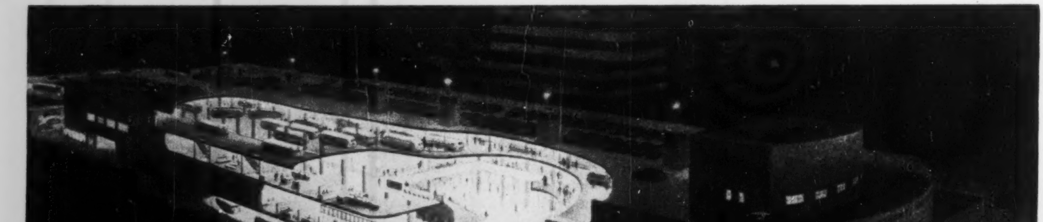
Speaking at the same ceremonies and at a large luncheon that followed, Governor Alfred E. Driscoll of New Jersey cited the terminal as an outstanding example of the good that can come from interstate cooperation and urged a meeting of all New York and New Jersey agencies concerned with transportation to develop a coordinated program of traffic interchange. In another leading talk, Traffic Commissioner Lloyd B. Reid, M. ASCE, stated that engineering possibilities for design and construction of relief facilities are limited only by what the public is willing to pay for.

Covering the full block bounded by Eighth and Ninth Avenues and 40th and 41st Streets, the five-level terminal is the largest in the world. It is designed to accommodate 2,500 buses entering and leaving the city each day and keep them from congested streets. Initially its facilities will serve all of the 19 short-haul bus lines entering mid-Manhattan and 13 of the 25 long-haul lines. A three-acre roof parking lot, with provision for 450 cars, is directly connected with the Lincoln Tunnel Plaza by a 1,500-ft overhead ramp. Automatic radiant heating will keep the ramp free of snow and ice. Other unusual features of the ultra-modern structure include a parking detector system and special lights at bus entrances to accustom drivers to the indirect lighting inside. Among the 31 escalators is one that moves at the unusual speed of 125 fpm for travelers in a hurry. In addition to housing the activities of the terminal, the structure will offer every possible type of shop and service for the comfort and convenience of travelers.

Plans for the giant union bus terminal have been under study by the Port Authority since 1944. Actual construction was delayed several years, pending passage of city legislation guaranteeing that no competitive terminals would be permitted in more favorable locations east of Eighth Avenue and bi-state legislation providing for a bond issue to finance the project. The necessity of relocating about 600 families living in the blocks required for the project also delayed construction.

Ground was broken for the project in January 1949, and the first steel erected in November of the same year. Under a contract held by the Turner Construction Co., of New York, the terminal was completed on November 1. Planning and design were handled by Port Authority engineers.

CUT-OUTS IN ARTIST'S RENDERING OF BUS TERMINAL show arrangement of floor levels. Long-haul buses use first floor, and short-haul lines the third floor. Intermediate levels are devoted to waiting rooms, ticket booths, shops, and services of all kinds. This sketch, by artist A. Leydenfrost, is reproduced through courtesy of "New York Times."



Large Railroad Construction Project Eliminates Bottleneck Tunnels

ONE OF LARGEST RAILROAD CUTS IN WORLD is being completed for Pennsylvania Railroad at Bowerston, Ohio, as part of $9,000,000 tunnel-elimination project on 45-mile stretch of railroad's main line between Steubenville and Dennison, Ohio. Project included construction of cuts to replace four old tunnels that were too small to admit large modern equipment and forced the detouring of 84,000 box cars annually. Measuring 660 ft long by 220 ft high with width of 80 ft at bottom and 600 ft at top, cut shown here involved moving of 2,500,000 cu yd of earth and rock and relaying of track at total cost of $2,865,000. Blasting and digging for cut were done by Hunkin Conkey Construction Co., Cleveland, Ohio. Berms 36 ft wide on each side, visible in photo, permitted use of heavy excavating and shovel equipment and served as protection to workmen against falls and other accidents during construction. Project is expected to save two days in freight haul time between Pittsburgh and St. Louis.

Construction Activity for November Continues at Unseasonal High

Expansion of nonresidential building in November held total construction activity at a record level for the season despite a decline in homebuilding, according to a joint release of the Building Materials Division of the Department of Commerce and the U.S. Labor Department's Bureau of Labor Statistics. Though the total value of all types of new construction put in place during the month, valued at more than $2.5 billion, was off 8 percent from October, it was 23 percent above the November 1949 total.

The rise in nonresidential building activity resulted from contra-seasonal gains of from 5 to 10 percent in commercial and industrial building and smaller increases in construction of religious, private educational, and hospital buildings. The limitation order on new construction for social and recreational purposes is already causing a slight decrease in construction activity on projects in that category, the joint agencies note.

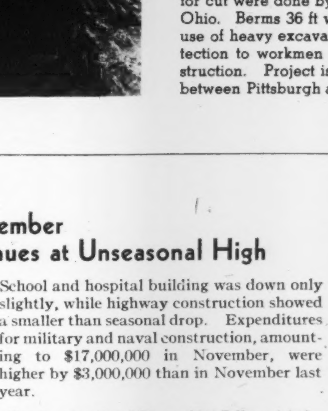
Further Decline in Homebuilding Noted

A further tapering-off in the 1950 housing boom was indicated by a larger-than-seasonal drop of 10 percent from October in the value of work done on new private residential buildings. However, at $1,020 million, the value of new private dwelling construction in November, was still 36 percent above a year ago, and the highest November total on record. Despite the decline of private homebuilding in November, it continued to be the largest single factor in establishing 1950 as the record year for expenditures on new construction. Private residential building accounted for 44 percent of the total value of all types of new construction in November, and for 45 percent of total new construction during the first eleven months of 1950.

The joint agencies report a decline in all types of public construction in November. School and hospital building was down only slightly, while highway construction showed a smaller than seasonal drop. Expenditures for military and naval construction, amounting to $17,000,000 in November, were higher by $3,000,000 than in November last year.

Construction Total Passes $25 Billion Mark

By the end of November, total outlays for new construction in 1950 had passed the $25 billion mark, exceeding the total for the first eleven months of 1949 by 22 percent. During the first eleven months of this year, private expenditures for new construction, amounting to $19 billion, were 28 percent higher than last year, while public expenditures valued at almost $6.5 billion were up 9 percent.



WHILE DEPARTMENT OF COMMERCE CURVES for November show slight seasonal decline from October, construction activity is 23 percent above November 1949 total.

AEC Selects Site for Atomic Energy Plants

Selection of a site for its new production plants, near Aiken, S. C., and Augusta, Ga., is announced by the Atomic Energy Commission. About 250,000 acres in Aiken and Barnwell counties, South Carolina, will be acquired for the site, which will be known as the Savannah River Plant. To be designed, built, and operated by the E. I. du Pont de Nemours Co., of Wilmington, Del., the plant will be devoted to the development of atomic energy for peacetime uses. Funds for starting construction were included in the $260,000,000 supplemental appropriation Congress voted last September at the request of the President. It is expected that the construction force will reach approximately 8,000 during the first six months of construction, which will be started early in 1951.

Accessibility to population centers to avoid establishing new government communities such as those at Oak Ridge and Los Alamos was a major factor in determining the location, which was chosen after a four-month study of more than 100 sites by the du Pont Co. and AEC engineers with the assistance of other federal agencies. ASCE members L. J. Sverdrup, of St. Louis, and A. T. Waidelich, of Cleveland, served on the Site Review Committee.

Design and construction will be handled by the du Pont Company's Engineering Department, with Robert K. Mason, Assoc. ASCE, field manager in charge of construction. Curtis A. Nelson, Assoc. M. ASCE, is manager of the Operations Office for the AEC, and his deputy is Robert C. Blair, M. ASCE.

New Jersey Turnpike to Have Asphalt Surfacing

After careful study of road surfacings from the standpoint of cost, durability, and safety, the New Jersey Turnpike Authority has selected asphaltic concrete for the pavement of its 118-mile superhighway, according to an announcement from Paul L. Troast, chairman of the Authority. This decision followed the receipt of alternate competitive bids on asphaltic concrete and portland cement concrete for the seven sections of the Turnpike.

Emphasizing the fact that "Either type of pavement would provide an equally excellent highway," Mr. Troast states that on the basis of the selection of shoulders decided upon by the Authority, the asphaltic concrete would cost $39,403,284 and portland cement concrete $44,823,418, a difference of $5,420,134 in favor of asphaltic concrete.

"This difference," said Mr. Troast, "would involve an additional investment and interest charges that are not economically justified in view of the assurances from our engineers that the asphaltic concrete will provide an excellent highway...the equivalent of portland cement concrete, and after a reasonable evaluation of maintenance costs in each case."

The pavement will consist of $4^1/_2$ in. of hot-mix asphaltic concrete laid over 8 in. of penetration bituminous and waterbound macadam, with both laid over a gravel base with a minimum thickness of 6 in. In addition, there will be a frost-free foundation. The total thickness of the pavement and frost-free material will range from 36 to 42 in., depending on surface sloping and drainage requirements. The inner and outer shoulders will be of a different surface material to provide a contrast and act as a guide to traffic.

"The aim of the Commissioners is to provide the best possible road at the best possible price, with consideration of maintenance costs," Mr. Troast said.

International Union of Engineers Proposed

Plans were laid for the establishment of a Union of International Engineering Organizations at a recent five-day meeting in Paris, held under the sponsorship of the United Nations Engineering, Scientific and Cultural Organization. A constitution was drafted by the assembly with the understanding that the proposed union would become effective as soon as ten of the fifteen international engineering organizations represented at the conference approved.

The objectives of the union as expressed in the constitution are: (1) to coordinate, by common agreement, the activities of the member organizations, and in particular the programs and dates of international congresses; (2) to take all useful steps for the moral and material support of the member organizations; (3) to receive proposals and make recommendations thereon, with a view to aiding the formation of new international organizations in fields not effectively covered by existing organizations; and (4) to further mutually helpful relations among the member organizations and similar organizations, and also relations between the member organizations, the UN and their Specialized Agencies.

The four delegates from the United States at the Paris conference included two ASCE members—Prof. Lorenz C. Straub, of Minneapolis, Minn., president of the International Association for Hydraulic Research, and Prof. Donald W. Taylor, of Cambridge, Mass., secretary of the International Society of Soil Mechanics and Foundation Engineering. Other international organizations represented at the conference included the International Association of Bridge and Structural Engineering, the World Power Conference, the International Commission on Large Dams, the International Commission on Irrigation and Canals, the Permanent International Association of Road Congresses and the International Federation of Surveyors.

Thruway Span Will Cross Hudson at Widest Point

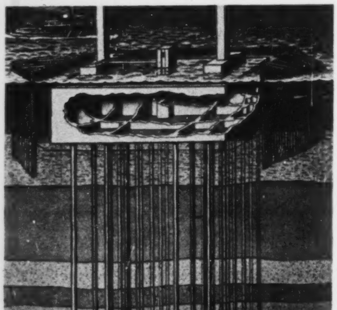
Selection of a site for the Hudson River crossing of the New York State Thruway—across the widest part of the river between South Nyack in Rockland County and Tarrytown in Westchester County—has been decided after months of controversy. Numerous arguments have been advanced for building the bridge across a narrower part of the Hudson, south of the location chosen by the Thruway Authority. The site picked is just north of the jurisdiction of the Port of New York Authority, which has an agreement with New York and New Jersey that no competitive toll crossings can be built within Port Authority boundaries.

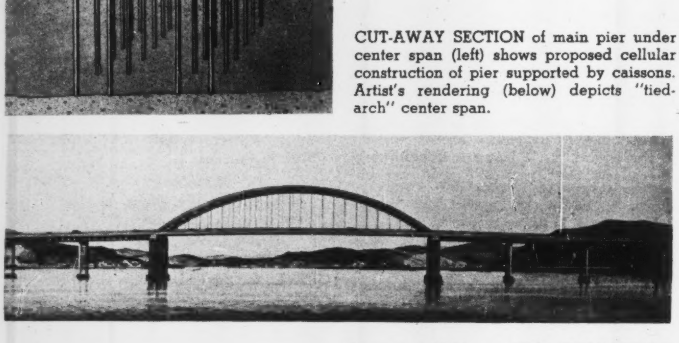
Use of an unusual construction technique will permit construction of the bridge across the Tappan Zee section of the river, which is 15,000 ft wide, at the relatively low cost of $65,000,000. On the Rockland County side of the river, the proposed Thruway will be carried over an earth-filled causeway connecting with a series of short steel spans leading to a 1,000-ft main arch over the principal navigation channel. With a height of more than 135 ft above the water level, the center span will permit the highest battleships to pass under it.

The bridge piers will be founded on hollow, reinforced concrete caissons, resting on the channel bed and depending partly for stability on their buoyancy. Steel cylinders 30 to 36-in. in diameter, filled with concrete, will extend through holes in the caissons to the sand and hardpan stratum, but will not be carried to bedrock 212 ft below the river surface.

Although details of the approaches have not been completely worked out, there will be at least three on the Rockland County side connecting the Thruway with Route 9W, the New Jersey Turnpike, and the Palisades Parkway. On the Westchester County side of the river, the bridge will pass over Route 9 and tie in with cross-country Route 119.

Studies and investigations for the bridge have been conducted by the New York City consulting engineering firm of Madigan-Hyland. Bertram D. Tallamy, Assoc. M. ASCE, New York State Superintendent of Public Works, has headed the Thruway Authority since its creation last March.





CUT-AWAY SECTION of main pier under center span (left) shows proposed cellular construction of pier supported by caissons. Artist's rendering (below) depicts "tied-arch" center span.

Unusual Types of Construction Feature Cuban Building Boom

M. D. MORRIS, Jun. M. ASCE, New York, N.Y.

Havana, the Paris of the Caribbean, is bustling with construction work. Everywhere in town, intermingling with its colonial charm, new structures rise, keeping pace with the modern world and yet avoiding clashing contrast between tradition and progress.

In addition to the new divided highway project connecting Havana with its airport, a dozen big local jobs for the Ministerio de Obras Publicas (Ministry of Public Works), under Dr. Manuel Febres Valdez, Minister, are under construction, along with a record number of private jobs that are equally startling to the eye of the visiting professional sidewalk superintendent.

As a typical example of each, one might have a look at a public market the Ministry is building, which has five levels of continuous floor space in a corkscrew arrangement eliminating stairways, or at a new theater going into the shell of the old.

The public market, Mercado Carlos Tercero (so called because of its location on Avenue Carlos III), is being built on a contract basis by Constructora Alberto Vadia, Sociedad Anonima. Originally begun in October 1947, construction stopped some months later, began again in December 1949, when government funds were again available, and is still under construction.

Designed by Arquitecto Manuel Carcera, the market building has exterior dimensions of approximately 213×233 ft surrounding an open patio or courtyard about 98×62 ft. The transverse floors, 85 ft wide, are level, and the 57-ft-wide longitudinal floors are inclined ramps so that the building's entire floor surface is continuous from basement to roof. The complete structure is of reinforced concrete. The bars are an American fusion-weld twisted steel bar type called Webrib, based on the old Austrian patent identified as Isteg. All other equipment and materials are U.S. standard.

According to Caesar Mederos, chief engineer on the project, the most difficult construction was in the foundation stage. The nearness of the project to the harbor, the high water table, and the pervious clay necessitated the use of steel sheeting and the constant operation of an extensive wellpoint system.

Just across town, an eyesore in a conspicuous location fronting the Capitolio, was the antiquated remains of Teatro Payret. The owners decided to raze the ruin and hired Cuba's noted engineer, A. Arellano and the architect, E. E. Batista, to build a new theater in its place.

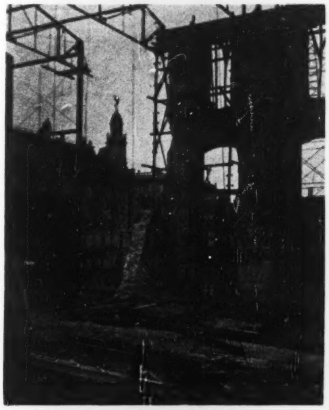
Demolition of the roof and interior was accomplished on schedule, but the skull-crackers found the masonry side and rear walls too tough. Work was halted while the walls were analyzed from top to foundation, and it was established beyond a doubt that the footings were excellent and the existing exterior masonry walls stronger than the designed walls. A minimum of revision of plans and specifications resulted in what appears to be the most unusual construction job in Cuba today.

The American Steel Company of Cuba, subcontracting the structure, had its chief engineer, Roue, design for fabrication a set of bastard trusses, from which a curved ceiling will be hung. The rest of the interior is to be tied to the sidewalls.

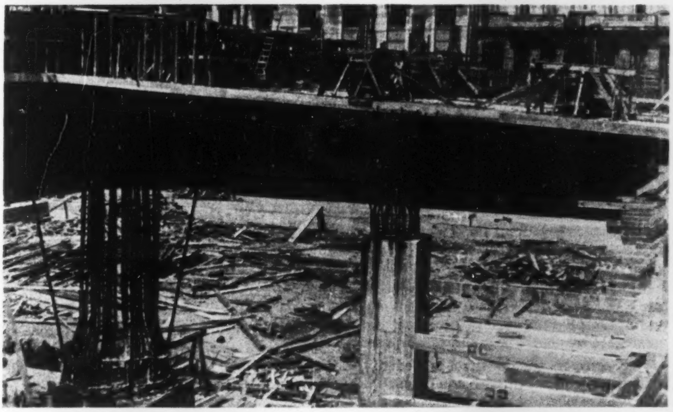
Each sidewall is capped with a reinforced concrete header beam on which the trusses are carried, the top chord resting on the header. The trusses, spanning 97.35 ft, are assembled on the ground and placed by crane.

The entire interior is designed of reinforced concrete. Delivery is by the largest transitmix concern in the country. The broad street permits free passage of delivery trucks without causing traffic congestion. A Towermobile raises the concrete over the sidewall, at which point it is chuted or carted to where it is needed at the moment. Resident Engineer Jorge Nunez G. states that the modern theme of the stage, arch, and complete interior necessitates a refacing of the old shell, to be done when the rest is complete. The undersides of the balcony and stairways are to follow the step pattern of the structure, eliminating the cost and excessive weight of plaster lofting.

These are only two glimpses of what is going on in Cuba and most other Latin-American countries today. Despite the slatted barriers, sidewalk superintendents are few. The average Cuban has begun to take construction work in stride. He is interested principally in results and leaves the details to those who know how.



FLOOR SLAB OF OPEN MARKET PLACE (lower view) winds upward for full five-story height of structure. Building needs no stairs and has none. Floors on long side of rectangular structure are inclined while those on short side are level. Structure is built around open courtyard. In left-hand photo steel roof trusses rest on ancient masonry walls of Teatro Payret. Design originally called for new bearing walls. However, engineers found old walls to be stronger than those specified in design and decided to use them.

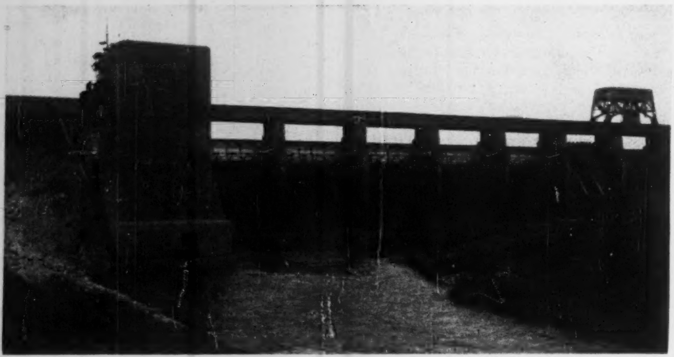


Large Steel Plant to Be Built in Cleveland

With award of a construction contract in excess of $30,000,000 to Koppers Co., of Pittsburgh, the Republic Steel Corp. will expand its facilities in the Cleveland area with a complete coke-oven plant and steelmaking facilities, including a large open-hearth plant. The contract includes two 63-oven batteries of Koppers-Becker underjet ovens, both of which will be underfired with blast furnace gas, and four 275-ton open-hearth furnaces. The coke plant will be built by the Engineering and Construction Division of Koppers, and the steel-producing facilities by the Freyn Engineering Co., of Chicago, a Koppers subsidiary.

Work on the contract will begin immediately with completion scheduled to permit production of steel in the new plant by January 1, 1952.

New Hydro Station Increases Santee-Cooper Capacity



GENERATING CAPACITY OF SANTEE-COOPER SYSTEM in South Carolina is increased by 2,000 kw, with recent completion of this new unit. Located at Santee River spillway, plant utilizes 500 cfs of water, previously wasted through spillway to meet requirements downstream. Intake is controlled by submerged reverse Tainter valve and connects with 8-ft-dia steel penstock leading to spiral casing of turbine. Flood conditions required placing generator 37 ft above normal tailwater resulting in height of 80 ft from foundation to top of parapet. All equipment can be moved by crane to roadway level through hatchways, and turbine can be dismantled and removed without disturbing generator. F. A. Dale, M. ASCE, consulting engineer of Cashiers, N. C. was designer of project. Plant is owned and operated by South Carolina Public Service Authority, of which J. H. Moore is chief engineer.

Coordinated Development of Water Resources by River Basins Recommended by President's Commission

Unification of the water resources of the nation "through enactment of a single national water resources policy law controlling the activities of the government departments as presently organized or as they may be organized," is recommended by the President's Water Resources Policy Commission in the first 446-page general section of a projected three-volume report. Appointed about a year ago to study existing federal legislation and policies in the water-resources field, the seven-man Commission, headed by Morris Cooke, will release the two final volumes of the report in February. The second volume will deal with *Ten Rivers in America's Future*, and the third, *Water Resources Law*.

The coordinated development of whole basins is favored by the Commission rather than the present "patchwork of plans by separate agencies for separate purposes." Conceding that "comprehensive, long-range plans must be worked out within each river basin," the report emphasizes that "nothing less than the whole country can be considered in the formulation of federal policies."

For a comprehensive program of river-basin development, the Commission lists for inclusion the following prime purposes in water-resources policy: watershed management, flood control, water supply, river transportation, hydroelectric power, irrigation, pollution abatement, drainage, recreational use of water resources, protection of fish and wild life, and control of sediment, salinity encroachment, and insects. "All these purposes have legitimate claims within one basin," the report states, "but if one is developed without regard to its effect on the others, conflicts and losses will occur."

According to the Commission, "the specific role of the federal government in developing our water resources is one of leadership—the provision of pertinent scientific and economic information as well as a public investment function on behalf of the entire nation." It avers that the plan for water development proposed in its report in no way contemplates "that the federal government should itself become a great monopolist." The government's purpose is stated to be, "to create the framework for the further expansion and healthy functioning of a free, competitive economy."

The recommendations of the President's Commission include:

1. Congress should provide that the unit for further water-resources development is the river basin, and each basin should be considered in relation to regional assets and needs.

2. At each step in the planning, authorization, and appropriation process, the basin program should be treated as a single program for all purposes rather than as an aggregate of plans for separate purposes.

3. Congress should direct all federal departments concerned with the development of water resources to review and coordinate all existing plans in cooperation with interested states.

4. Congress should authorize creation of separate river basin commissions to coordinate the surveys, construction activities, and operations of the federal agencies in the several river basins.

5. The President should appoint a National Board of Review, subject to Senate confirmation, to analyze and review all projects recommended by basin commissions prior to their presentation to Congress.

6. Congress should direct all federal agencies responsible for the development of water and land resources to review all existing plans and coordinate them for the comprehensive development of the several river basins.

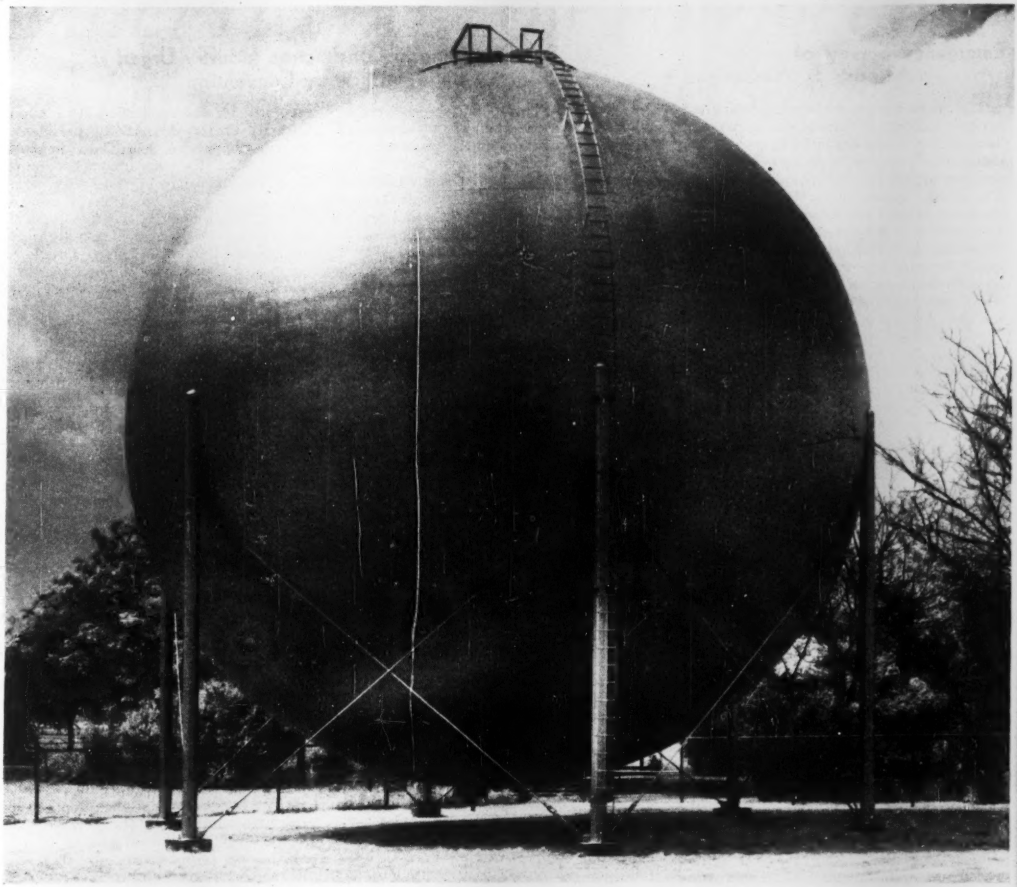
7. Congress should make an annual appropriation to each river basin commission for its activities.

8. In drafting new legislation, Congress should provide for a uniform national reimbursement policy based on the following considerations: (a) for domestic and industrial water supply and hydroelectric power, full repayment of costs including operation and maintenance, interest and payments in lieu of taxes on acquired properties; (b) for irrigation, drainage, and watershed management, payment without interest based on ability to pay as measured by land operators' increased earnings; (c) for navigation, reimbursement should be determined by putting charges for all forms of transportation on a cost basis; (d) for other primary and secondary benefits, reimbursement should be shared by the states; and (e) for general welfare benefits, the responsibility should be that of the federal government.

9. While readjustments are being made in the whole process of presenting river basin programs to Congress, projects now under construction should be pushed to completion as rapidly as the national emergency permits. First priority on new construction should be given to projects that will safeguard projects already built, and to projects that will develop new regional activities—such as by the development and distribution of hydroelectric power.

The report states that the government, having a substantial investment in existing water resources improvements, will spend $1.2 billion in 1951, and that authorizations for another $12 billion have been made. Admitting the impossibility of estimating the whole cost of improving the basin projects envisaged in its report, the Commission believes that "an adequate conservation and development program for renewable resources over the next generation might cost the nation in the neighborhood of $100 billion.

In addition to Chairman Cooke, the Commission consists of Dean Paul S. Burgess, College of Agriculture, University of Arizona; President Lewis W. Jones, University of Arkansas; Samuel B. Morris, M. ASCE, chief engineer and general manager, Los Angeles Department of Water and Power; Leland Olds, New York; President Roland R. Renne, Montana State College; and President Gilbert White, Haverford College.



Dayton installs Hortonsphere for easier maintenance

The 50-ft. diam. Hortonsphere illustrated above is a part of a long-range improvement program at the Dayton, Ohio, sewage treatment plant.

This program started in 1942. During that year, the sludge volume increased 29 per cent. So, to increase sludge-drying capacity, the plant added 71,000 sq. ft. of drying beds. Then, in 1948, a series of improvements were begun to boost trickling filter capacity from 32 to 64 million gallons per day. In 1949, four 1,250,000-gal. digestion tanks, with provision for sludge heating, were added.

To handle the gas from these new digesters, the plant increased gas storage capacity 300 per cent. The original gas storage capacity at Dayton consisted of five underground cylindrical tanks. Experience had shown that preventive maintenance on underground tanks is expensive. So this time the engineers specified a Hortonsphere. Hortonspheres are readily accessible for inspection or painting. Furthermore, they require only *one* set of piping connections and fittings in contrast to the several sets necessary when a battery of smaller tanks are used to provide the same storage capacity.

The versatile Hortonsphere has many other applications. Petroleum refiners use it to store volatile hydrocarbons like butane. Chemical processors store anhydrous ammonia in it. Gas companies often select the Hortonsphere for storing the reserve needed to meet daily peak loads.

Our Bulletin F describes the Hortonsphere and its advantages in detail. You can get a copy by writing our nearest office.

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Detroit 26............1541 Lafayette Bldg.
Havana....................402 Abreu Bldg.
Houston 2....2128 National Standard Bldg.
Los Angeles 14 1556 General Petroleum Bldg.
New York 6.....3395—165 Broadway Bldg.
Philadelphia 3..1652—1700 Walnut St. Bldg.
Salt Lake City 4....509 West 17th South St.
San Francisco 4........1584—200 Bush St.
Seattle 1..................1309 Henry Bldg.
Tulsa 3...................1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

Emergency Survey of Airports Is Authorized

Surveys to determine the adequacy of the nation's airports in time of emergency will be made in thirteen key cities by an aviation industry-government task group as part of the over-all mobilization planning program. The group, appointed by D. W. Rentzel, chairman of the Civil Aeronautics Board, in his capacity as general chairman of the Air Transport Mobilization Survey of the National Security Resources Board, will make recommendations on airport development, maintenance and use agreements in time of national emergency.

Ways and means of getting maximum use of the airports for both civil and military needs will be one of the objectives of the task group. Consideration will also be given to needed emergency airport improvements and their value to the nation as peacetime assets.

Steel Production for Year Nears Wartime Peak Output

In eleven months of 1950 steel production totaled 88,348,655 tons, an increase of 25.8 percent over the 70,249,952 tons made in the comparable period of 1949, and only about 1.5 percent lower than the highest annual production ever achieved—in the war year of 1944. These figures are released by the American Iron and Steel Institute, which also reports that November was the eighth consecutive month in which steel production exceeded 8,000,000 tons.

The total output during November was about 733,000 tons lower than in October, when 8,740,095 tons of steel were made. The decline is attributed largely to the severe storms that paralyzed industrial activity in the Middle West at the end of November. Steelmaking furnaces during the month were operated at an average of 96.8 percent of capacity, compared with an average of 102.3 percent of capacity in October. In November 1949, when the steel companies were feeling the effects of the long steel strike, production totaled only 4,223,129 tons, and furnaces were operating at an average of 53.4 percent of capacity.

Army Engineers to Construct 1,250-Bed Veterans' Hospital

Availability of plans and specifications to prospective bidders for the construction of a 1,250-bed veterans' hospital is announced by Col. E. P. Ketchum, district engineer, Corps of Engineers, Department of the Army, 80 Lafayette Street, New York, N. Y. To be located between 1st Avenue and Avenue A and 23rd and 25th Streets in New York City, the project will include a 19-story main hospital building, staff and nurses' buildings, attendants' quarters and garage, site improvements, utilities, and landscaping.

Bids must be submitted to Colonel Ketchum's office by January 30, 1951.

Self-Discipline in Construction Industry Urged at Building Industry Convention

A united, self-disciplined construction industry is essential to meet the demands of defense preparedness and to maintain the "strength of free enterprise against the enervating weakness of a managed economy" as represented by the imposition of unnecessary federal restrictions and regulations, according to Carlton S. Proctor, former Vice-President of ASCE and member of the New York consulting engineering firm of Moran, Proctor, Freeman & Mueser.

Speaking at the 55th annual convention of the Building Industry Employers of New York State, held at the headquarters of the Building Trades Employers' Association of New York City on December 15, Mr. Proctor urged the building industry to "organize its own disciplinary procedures to effectuate necessary cooperation with the national defense program to encourage the minimum amount of federally imposed restriction, allocation, and price-fixing."

A five-point program of individual action, through which contractors can personally help mobilize the construction industry for the vital role it must play in national preparedness was outlined by Rear Admiral Carl H. Cotter, M. ASCE, president of Merritt-Chapman & Scott Corp., in another major talk. He suggested (1) planning ahead for greater mobility in terms of preparedness to enter new fields of construction; (2) planning in advance against a drain on supervisory personnel as more men are absorbed into the armed forces; (3) emphasizing conservation of material in seeking substitutions for materials in critically short supply; (4) working to minimize maintenance problems by encouraging standardization of equipment and parts; and (5) approaching management problems "with full realization that they are an inseparable part of a long and grim program that is going to make exacting demands on every segment of American economy."

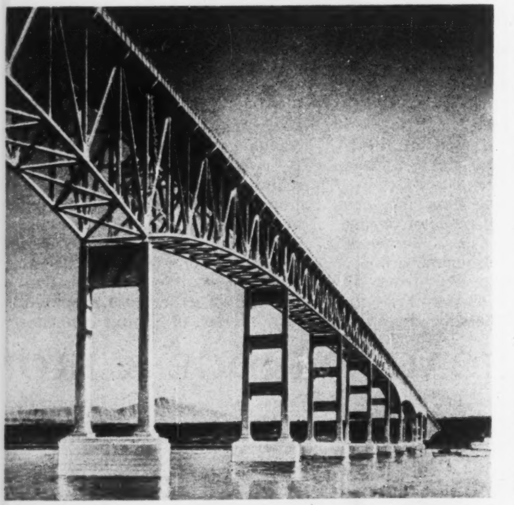
More than 300 contractors from 23 cities attended the convention. The group's new officers for the coming year are Francis Byrnes, president, and Maurice Rowley, vice-president. William J. Picard was reelected secretary-treasurer.

Army Approves Plans for Mid-Hudson River Bridge

The location and plans for the Kingston-Rhinecliff Bridge over the Hudson River have been approved by the Department of the Army, according to an announcement from James F. Loughran, Assoc. M. ASCE, chairman of the New York State Bridge Authority. The site chosen is about four miles north of the Rondout Creek at Kingston, where the river is 4,400 ft wide.

Designed by D. B. Steinman, M. ASCE, consulting engineer of New York City, the four-lane bridge will be a continuous deck structure with 800-ft spans over the two channels. Total length of the bridge, including the approaches, will be 7,580 ft. The cost of the bridge and facilities, excluding right-of-way, legal, and engineering charges, is estimated at $18,500,000. All plans were developed under the supervision of Mr. Loughran, and the adopted design has been approved by the New York State Department of Public Works.

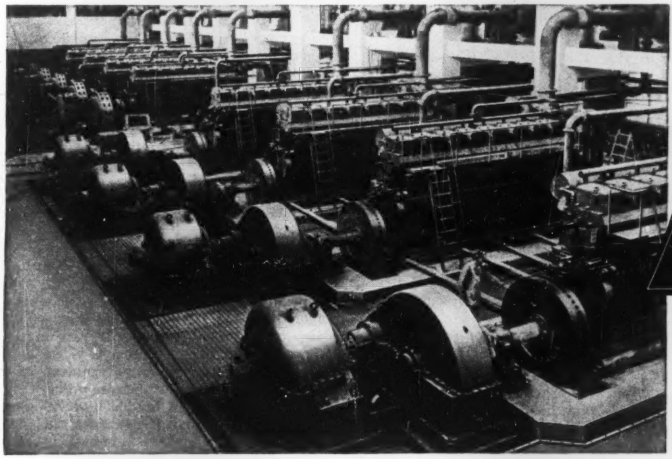
Highway connections to the bridge, amounting to some twelve miles of new four-lane roadway, will be contributed by the state and built under the direction of Bertram D. Tallamy, Assoc. M. ASCE, state superintendent of public works. Scheduled for completion in 1953, the bridge will be an important arterial link connecting the present northern end of the Taconic Parkway on the east side of the river with the authorized southern end of the Thruway on the west side.



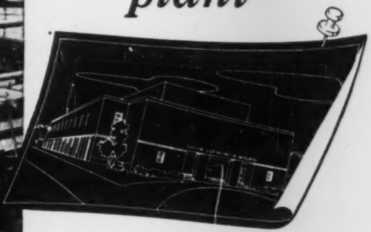
DECK-TYPE CONSTRUCTION for Mid-Hudson Bridge, without overhead steelwork, will permit unobstructed view of river.

EXCEPTIONAL LOW POWER COST

for huge new Los Angeles sewage disposal plant



Nine Supercharged, Dual Fuel Worthington Engines, of 1688 hp each, installed at the new Hyperion Sewage Treatment Plant, Los Angeles, California



Worthington Supercharged Dual Fuel Engines to Supply 15,000 hp ...for only the cost of pilot fuel!

Now being built at a cost of approximately $41 million, Los Angeles' new Hyperion sewage disposal plant will be the most modern and efficient in the world. Designed to handle an average daily flow of 245 million gallons of raw sewage, this modern "high-rate" plant will feature the most advanced engineering in every detail of operation.

Nine Worthington Dual Fuel engines are to be the entire power source. Five will drive generators, and the other four will drive blowers. The Hyperion plant will operate at exceptionally low cost, thanks to: (1) the Worthington-pioneered dual fuel principle, permitting the use of gas, oil, or gas and oil in any ratio; (2) supercharging, which provides maximum power for available space, and with the utilization of high-temperature water cooling and exhaust heat recovery system, results in highest thermal efficiency.

SEWAGE GAS THE FUEL

These Worthington engines will normally run on raw sewage gas, utilizing pilot oil to ignite the gas. *Fuel expenses under ordinary conditions, therefore, will be only the cost of pilot oil.* However, should there ever be a shortage of sewage gas, the engines will automatically shift to oil fuel, in the necessary ratio. This gas-oil ratio can also be controlled manually.

FOR EVERY SIZE OF PLANT

In addition to Dual Fuel Engines, Worthington makes a wide range of Diesels, pumps, comminutors, and other equipment, to meet the requirements of sewage treatment plants of every size from the smallest to the largest. For further facts on the trouble-free, cost-saving engine performance that proves *there's more worth in Worthington,* write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

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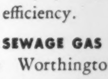
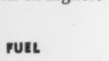
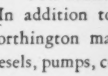


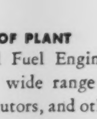
Balanced Angle Compressors



Oil Transfer Pumps



Cooling Water Circulating Pumps



Evaporative Type Engine Water Cooler

N. G. NEARE'S Column

R. Robinson Rowe, M. ASCE

"I have," confessed Professor Neare, "a confession to make. Being a hybrid engineer, with the *Hy* from hydraulic and the *brid* from bridge, I have long been as loyal to contract bridge as to bridge contracts, but lately I have been playing canasta. Not only playing canasta, but liking it. In mitigation, however, let me add that my enjoyment is due in large measure to the novel elements of chance, one example of which I would like to offer as the first problem of 1951. What is the chance of not holding a natural or mixed pair in your hand after completing the first draw?

"And now that Guest Professor Flo Ridan is ready to discuss the current assignment of drawing a bull ring thru three corrals, I can sneak away to a canasta tournament. You are ready, aren't you Flo?"

"I am if Joe Kerr is, Noah."

"Me, I'm not," said Joe. "Simultaneous quadratics always were my nemesis. I set up the equations by spotting the origin at the southwest corner of the field. Letting x, y *and* r be the center coordinates and radius of the bull ring, D, then the square of AD is $(x-11)^2 + (y-8)^2$. Now the diameter connecting the gates of A will be perpendicuar to AD, so $r^2 = (x-11)^2 + (y-8)^2 + 8^2$. Obtaining similar relations for corrals B and C and expanding gave me three quadratics in three unknowns,

$$\left.\begin{aligned} x^2 + y^2 - 22x - 16y + 249 &= r^2 \\ x^2 + y^2 - 64x - 24y + 1249 &= r^2 \\ x^2 + y^2 - 24x - 58y + 1129 &= r^2 \end{aligned}\right\} \ldots (1)$$

"I solved the first equation for x in terms of y and r and substituted in the other two, getting stupendous expressions. I showed them to Cal and he laughed out loud!"

"Why shouldn't I?" asked Cal Klater. "Substitute for r^2 instead of x, or, better yet, subtract one equation from the other two and you get linear equations like:

$$\left.\begin{aligned} 2x + 42y &= 880 \\ 42x + 8y &= 1000 \end{aligned}\right\} \ldots\ldots\ldots (2)$$

from which $x = y = 20$. Then from (1), $r = 17$."

"Fine," said Professor Ridan. "The problem was stated, 'Can you figure it or draw it?' You figured it; did anyone draw it?"

"I did," said Ken Bridgewater. "In Fig. 1, draw radii AE and BF perpendicular to AB. Bisect EF at G and erect a perpendicular intersecting AB at H. Then a perpendicular to AB at H will pass thru D, so a similar construction starting with AC will lead to an intersection to locate D. Draw DA and radius AJ perpendicular to DA, and finally, construct the bull ring with center at D and radius DJ."

"Simply said and done," concluded the Guest Professor, "and if anyone doesn't believe it's so, let him try to prove it isn't."

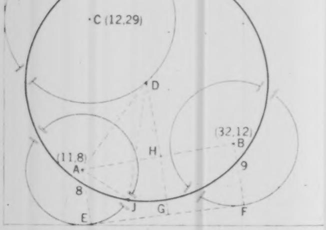


FIG. 1. HOW KEN DREW the bull ring thru diametrical gates of the three corrals.

[*Cal Klaters were: Ed C. Holt Jr., A. Nuther Nutt, John W. Courter, T. J. Hogg, Wm. C. Hunter, G. Nyuss (Robt. M. Dodds), Richard Jenney, Stoop (John L.) Nagle, Frank A. Randall, Jr., Francis E. Pray, Robt. Solomon Johnson, Fred W. Morrill, Geo. C. Stewart, William Sussman, Don'T (Donald Thayer), Kum Pewter (Walter Steinbruch), Ludwig Adams, Thatchrite (Guy C. Thatcher), Norman O. Geuder, and X. Sauer Doe (Marvin A. Larson).*

Guest Professor Ridan was Charles G. Edson. Also acknowledged is a unique solution of the September rooster teaser from Edward Hutchins.]

Urban Problems and Defense Planning Studied at Chamber of Commerce Conference

The impact of the defense program on the development of the nation's cities and towns was a major subject of discussion at the recent two-day Businessmen's Conference on Urban Problems sponsored by the Chamber of Commerce of the United States in Washington, D.C. A feature of the program was a luncheon address by the newly named Defense Transportation Administrator James K. Knudson, who discussed emergency measures that may become necessary to conserve and improve operation of local transportation, storage and port facilities.

In an opening panel discussion on "Urban Development and the National Security," J. W. Follin, M. ASCE, special assistant to the administrator of the General Services Administration, described a plan to move certain essential federal agencies from downtown Washington to new centers on the outskirts of the city. Tentative plans, Mr. Follin said, call for construction of new government buildings for approximately 40,000 employees at four locations in the outskirts of the Washington metropolitan area. He indicated that this was the beginning of an extensive plan that might eventually result in as many as 100,000 employees being located permanently in a number of dispersed locations.

Such a proposal, he said, is predicated on furnishing high-speed transportation to enable the dispersed agencies to maintain expeditious contact with each other and with the White House and Congress. Stating that the government has no intention, through its capital dispersal program, of undertaking to control development elsewhere, Mr. Follin declared that the need for dispersal is probably greater in Washington than in any other city because of the concentration of the entire government in a downtown area of a few square miles.

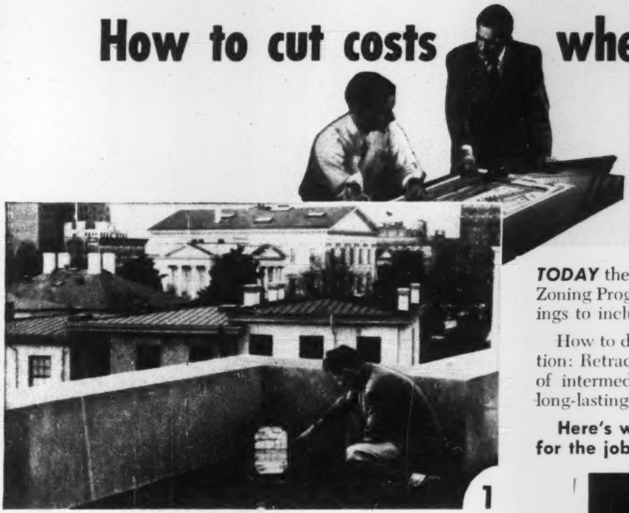
The technical help needed in developing master plans for traffic arteries and the financial assistance required in making them work were outlined by Bertram D. Tallamy, Assoc. M. ASCE, superintendent of the New York State Department of Public Works, in a session on Urban Traffic Improvement. In a panel discussion on Urban Redevelopment, Park H. Martin, M. ASCE, executive director of the Allegheny Conference on Community Development, described the Golden Triangle Improvement Program under way in Pittsburgh. The comprehensive program includes a highly successful smoke-control project, a park project, and a parking program involving construction of an underground garage and a large parking park. Without the cooperation of all levels of government—state, city, and county—and the leadership of executives in commerce and industry, Mr. Martin emphasized, such a program would not be possible.

More than 300 engineers and government and industrial authorities took part in the two-day conference, which was called in the belief that businessmen can play a decisive role in helping their communities solve today's pressing problems of overcrowded streets and slum areas. Co-sponsors were the Chamber's Construction-Civic Development and the Transportation-Communication Departments.

Engineers Needed for Indian Power Project

Recruitment is now in process for tunnel construction superintendents and other engineers on the Bhakra-Nangal Project in India, according to an announcement from the Government of India Information Services. Candidates should apply to A. J. McCusker, India Supply Mission, 635 F Street, Washington, D.C.

How to cut costs when drafting revisions are necessary



* **A case history based on the experience of the Virginia Department of Highways**

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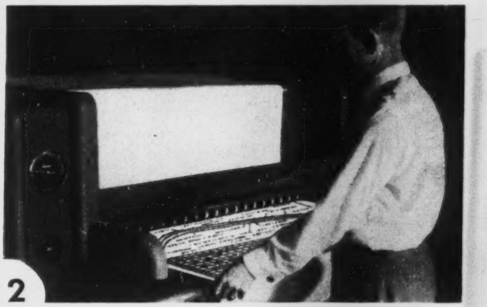

2

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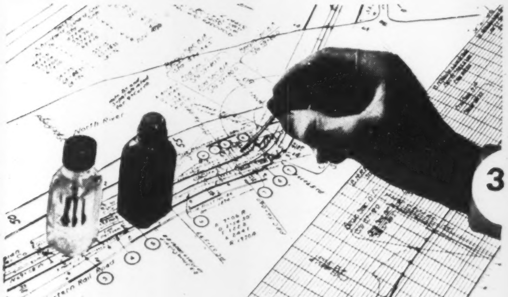

3

Drafting revisions are easily made. Unwanted details—such as existing right of ways—are removed quickly from "Autopositives" with corrector fluid. Then the proposed right of ways are drawn in with pencil or ink. Thus, new masters—prepared without costly redrafting—are ready to turn out the blueprints needed for county supervisors and resident engineers.

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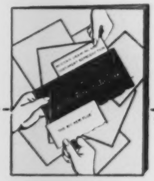

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George L. Christy

George Lewis Christy (M. '05) since 1914 chief engineer for the Pittsburgh-Des Moines Steel Co., and its predecessor firm, the Des Moines Bridge & Iron Works, Pittsburgh, Pa., died there on October 21. He was 83 and a graduate of Iowa State College. Mr. Christy began his engineering career with F. C. Rossiter, of Chicago, Ill. He then was engaged by the engineering department of Edge Moor Bridge Works and D. W. Church, of Chicago, and later was with Lewinson & Just, of New York City, successively as draftsman, chief draftsman, and chief engineer and vice-president.

Thomas Edward Collins (M. '27) for the past 38 years city engineer of Elizabeth, N.J., died on December 5, at the age of 69. Earlier Mr. Collins worked in the Pennsylvania Railroad's engineering department on construction of the East River tunnel linking New York's Pennsylvania Station with the Sunnyside yards in Queens. He had served as a member of the New Jersey State Highway Commission and the State Planning Commission. He attended the U.S. Naval Academy and Columbia University.

Hendrik Cornelissen (Jun. M. '38) for a number of years design and construction engineer in the engineering firm, Cornelissen & Salzedo, at Barranquilla, Colombia, died on June 4, at the age of 33. He was a graduate of Rensselaer Polytechnic Institute.

Guy Hamilton Derrick (M. '10) of Marion, Va., died in Westchester, Pa., on November 10. He was 80. For many years Mr. Derrick was construction engineer for the Norfolk & Western and the Sante Fe railroads. Before his retirement in 1940 he acted as senior engineer for the New Jersey Highway Department.

Alexander Gordon Finnie (Assoc. M. '32) with Raymond-Hegeman at Barcelona, Venezuela, died there recently, at the age of 49. Mr. Finnie had been with the Washington Suburban Sanitary District; the Washington, D.C., District Sanitary Engineer; and W. N. Brown, of Washington, D.C. Later as general superintendant of the Fishers Island Corp., Fishers Island, N.Y., he had charge of real estate development in that area. He was a George Washington University graduate.

Gustavus Adolphus Gessner (M. '05) of Toledo, Ohio, died recently, at the age of 81. Mr. Gessner was a member of the Toledo consulting engineering firm of Riggs & Sherman for many years. Earlier he had been engaged in the design and superintendence of construction of sewerage systems and other municipal work. He received his engineering training at Oberlin College and Lehigh University.

Van Lee Halferty (Jun. M. '49) of Poplar Bluff, Mo., was killed in action in Korea on September 1. He was 24. Lieutenant Halferty was an observer for his unit in the 38th Field Artillery Battalion of the U.S. Army's Second Division. He graduated from the University of Missouri, where he was a member of the ASCE Student Chapter.

George Cecil Hoffman (Jun. M. '50) who was with the U.S. Geological Survey's Photogrammetry Section, at Rolla, Mo., was killed in an automobile accident in Indiana on November 2. His age was 26. He received his civil engineering degree at the Missouri School of Mines last year and had been a member of the Society's Student Chapter there.

Frank Hogan (Assoc. M.'34) chief engineer, John H. French Co., New York, N.Y., died on September 4, at the age of 49. He had been connected with Sigmund Shushny, consulting engineer, Vienna, Austria, and consulting firms in the United States and South America. Mr. Hogan worked on the design of many steel and reinforced concrete structures in New York City, includ-

(Continued on page 82)

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(*Continued from page 81*)

ing the Roxy Theater. He was educated in Vienna.

George Percival Holland (Assoc. M. '43) senior resident engineer for the Tennessee State Highway Department, at Knoxville, Tenn., died there on October 30. He was 54. For several years Mr. Holland worked for the Louisville & Nashville Railroad and the Southern Railway. As resident engineer for the North Carolina Highway Commission, he had charge of drainage, paving, and surfacing operations in Avery and Haywood counties (North Carolina). He had also been with the Tennessee Valley Authority.

Langley Stoddard Homer (M. '40) since 1942 general superintendent for the Turner Construction Co., at Philadelphia, Pa., died in Boston, Mass., on December 12, at the age of 60. Mr. Homer had been associated with the company for the past 30 years. During the first World War he served in the Corps of Engineers in France. He graduated from Rensselaer Polytechnic Institute.

Gavin Nelson Houston (M. '09) retired consulting engineer of Olds, Alberta, Canada, died recently. He was 79. An expert on irrigation, Mr. Houston developed many projects in southern Alberta for the Reclamation Service of Canada. He had been lecturing at the School of Agriculture at Olds since his retirement from private practice. A graduate of Princeton University, he was the author of numerous papers on irrigation in ASCE TRANSACTIONS.

Joseph Withers Ivy (Assoc. M. '25) Western sales manager, National Cast Iron Pipe Co., Kansas City, Mo., died on November 3. His age was 63. In 1911 Mr. Ivy entered the employ of the American Cast Iron Pipe Co., Kansas City, Mo., and later became Western sales manager of the National Cast Iron Pipe Co. He was president of the Kansas Municipal Utilities Suppliers Association and belonged to the Kansas Engineers Society, the American Water Works Association, and other professional organizations. He was a graduate of Georgia Institute of Technology.

Theodore Sedgwick Johnson (M. '39) professor of sanitary and hydraulic engineering, North Carolina State College, Raleigh, N.C., died on November 5, at the age of 65. Professor Johnson had also taught engineering at Cornell and Denison universities. During leaves from his teaching duties, he served as state director of civilian defense, state rationing administrator, state director of the OPA, chief engineer of the State Department of Conservation and Development, Water Resources Division, and as consultant to various agencies. He received his engineering education at Denison and Ohio State universities.

Halbert Stevens Kerr (M. '08) who recently retired as senior engineer for the Utah State Road Commission, Salt Lake City, Utah, died on October 30, at the age of 85. Mr. Kerr entered the service of the commission in 1917 and became chief engineer in 1926. For 34 years prior to this, he was engaged in railroad work in the United States, Peru, and Mexico.

Henry Jacob Kolb (M. '29) former chief engineer for the BMT Division of the New York City Transit System, died on July 14, at the age of 73. Mr. Kolb began his career with C. E. C. Breck, of Boston, Mass., in 1897. An authority on railroad engineering, he served the New York, New Haven & Hartford, the Pennsylvania, the New York Central and Hudson River railroads, and the various municipal transit systems in New York. He was educated at Adams Academy and Massachusetts Institute of Technology.

Fred Lavis (M. '06) retired consulting engineer and transportation authority of Scarsdale, N.Y., died in Phoenix, Ariz., on November 24. He was 79. Mr. Lavis was engaged in railway work, location, and construction in the United States and in Latin America up to 1909, when he established a consulting practice in New York City, specializing in transportation. He had served as an engineer for the New Jersey Highway Commission and the Ministry of Public Works in Venezuela. Author of a number of papers on highway engineering subjects, he received the Society's Arthur M. Wellington Prize for papers in TRANSACTIONS in 1932 and 1941.

Fred Lavis

Charles Henry Nichols (M. '05) retired consulting engineer of Nichols, Conn., died in Bridgeport, on December 2. His age was 80. Upon his graduation from the Sheffield Scientific School at Yale University in 1892, Mr. Nichols joined the New York, New Haven & Hartford Railroad, where he remained until 1917. He then engaged in general and industrial engineering practice in New Haven. During World War I he served as a major in the Engineer Corps and later became a colonel in the Reserve.

John Calvin Oakes (M. '10) retired Army Corps of Engineers officer and former member of the Board of Rivers and Harbors, Washington, D.C., died in a hospital there on November 11, at the age of 79. Colonel Oakes went to Washington in 1903, when he was appointed to the Army's General Staff. He served as secretary of the Advisory Board of Consulting Engineers for the Panama Canal. Since his retirement in 1927, he had lived in Charleston, S.C. He graduated from the College of the City of New York in 1893 and from West Point in 1897.

John Wesley Odell (M. '38) engineer with A. S. Wilkstrom, Skaneateles, N.Y., died on July 21. His age was 52. Upon his graduation from Tri-State College, Mr. Odell became job engineer for the Great Lakes Dredge and Dock Co., Buffalo Division, and in 1927 was appointed division engineer for this organization at Buffalo.

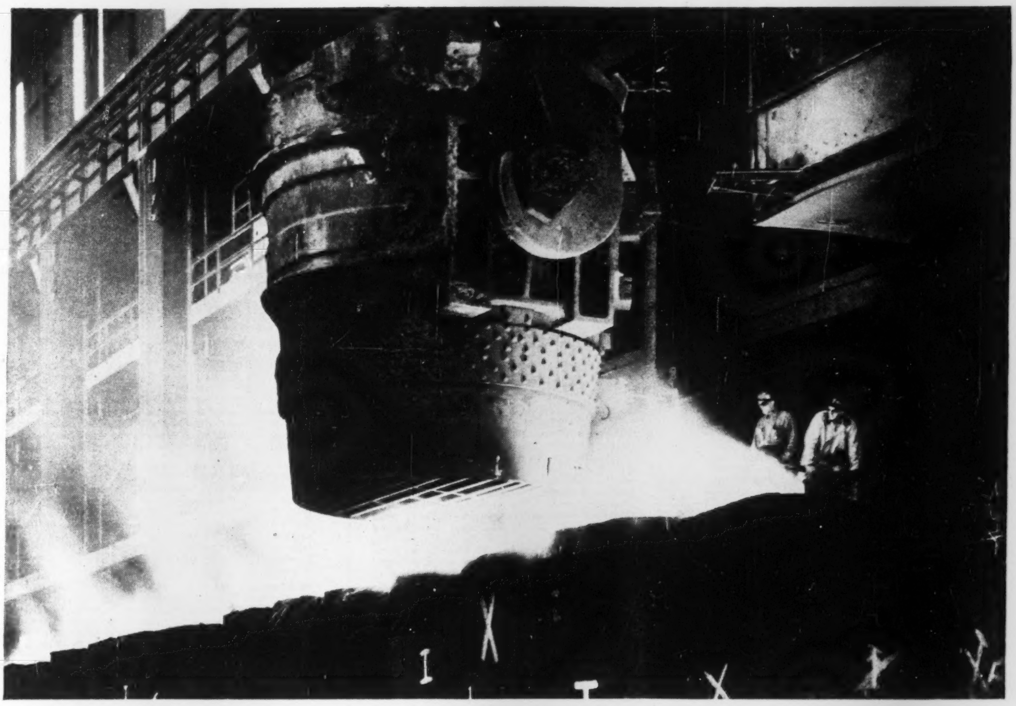
Porter Johnstone Preston (M. '22) of Denver, Colo., died on September 20. His age was 79. Upon his graduation from Colorado State Agricultural College in 1892, Mr. Preston was employed in the Colorado State Engineer's office, as hydrographer. Later he was engaged on irrigation work in Arkansas, Idaho, Montana, and Colorado. For some time he served the U.S. Reclamation Service, reviewing costs chargeable to water users of Uncompahgre, Grand Valley, North Platte, and Belle Fourche projects.

Edward Dunbar Rich (M. '08) of Lansing, Mich., died on September 29, at the age of 81. In engineering work for more than 50 years, Mr. Rich had been city engineer of Summit, N.J.; assistant professor of civil engineering at the University of Michigan; and director of the Bureau of Engineering for the Michigan Department of Health. He retired as director of the bureau in 1940. Earlier he had been employed by various municipalities and railroads in a consulting capacity. He was a Rensselaer Polytechnic Institute graduate, class of 1895.

Josiah Roscoe Sharp (Assoc. M. '28) associate mechanical engineer for the Tennessee Valley Authority, at Knoxville, Tenn., died on November 14, at the age of 59. Mr. Sharp began his career in 1908 with Otis Madden Townsend, architect of Ocean City, N.J. He had been connected with the Pennsylvania Railroad, the American International Shipbuilding Corp., and the General Electric Co. He was educated at Drexel Institute of Technology.

Herbert Lee Weaver (Assoc. M. '26) civil engineer and landscape architect, of Baltimore, Md., died there on November 17. His age was 58. Mr. Weaver worked for both the city and state before embarking on a career as civil engineer and landscape architect with Roland Park Co. and G. W. Stephens, Jr. & Associates, of Towson, Md. He was a member of the Engineers Club of Baltimore, the American Water Works Association, and the Maryland-Delaware Water and Sewerage Association, and a graduate of Polytechnic Institute in Baltimore.

William Preston Wooten (M. '08) retired Army Corps of Engineers officer and former editor of *The Military Engineer*, died in Washington, D.C., on December 12. He was 77. He served in the Philippines during the Spanish-American War, and subsequently was stationed at various posts in Hawaii and the United States until he was named commander of the 14th Engineer Regiment in France. He was then appointed chief of the Third Army. General Wooten, who retired in 1930, had charge of the initial survey of the St. Lawrence River and of levee construction and flood control work on the lower Mississippi River. He was a graduate of the University of North Carolina, West Point, and the Army War College.



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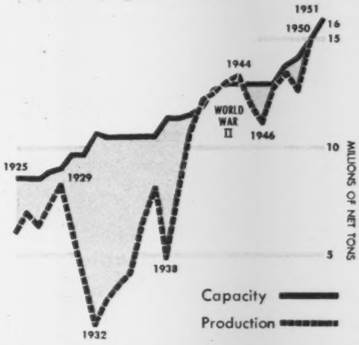

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CIVIL ENGINEER; Jun. M. ASCE; registered C.E. in California; B.S. and M.S. in civil engineering, 1942 and 1944, California Tech; will receive Ph.D. in civil engineering in June, University of Michigan; 30; married; 2 children; good knowledge of Spanish; 3 years construction, 3 years administration, 1 year structural design, 1 year teaching; 2 years in Latin America. Will consider any position with future at home or abroad. Available in March. C-644.

CIVIL ENGINEER; Assoc. M. ASCE; 30; from India; master's degree in civil engineering from a United States university; 1 year's training with the U.S. Bureau of Reclamation; 8 years' engineering experience in various capacities in India; desires association with American engineering company. Prepared to work in India or thereabouts, but preferably in India. E-645.

CIVIL ENGINEER; Assoc. M. ASCE; B.S.C.E. 1938; 35; married; 12 years' civil engineering experience in U.S. and Latin America. Projects included developing water resources, hydroelectric, irrigation, flood control, navigation canals, and construction. Engaged in project planning, estimates, report writing, and supervision field surveys. Speaks Spanish fluently. U.S. or Latin America. C-646-502-A-6-San Francisco.

CIVIL ENGINEER; Jun. M. ASCE; B.S. in C.E., 29; family; veteran; registered civil engineer in Kentucky; 7 years' experience in design and construction of various type structures. Architectural experience and engineering administration. Desires permanent employment with architectural-engineering or consulting firm. Prefers East Coast. C-647.

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Civil Engineer, graduate, for architectural design. Must have had experience on building construction and know actual design work. Will act as liaison between engineering group and operating department. Will be required to make recommendations, check designs, know cost of materials and also building code. Location, New York State. Y-4325.

Engineers. (*a*) Chief of Party with some experience in layout construction work, determination of quantities, etc., and instrumentmen acting under the guidance of the chief. (*b*) Concrete Technician with construction experience, to supervise and control the concrete mix and testing. (*c*) Inspector experienced in concrete construction. (*d*) Civil Engineers experienced in practical soil mechanics and laboratory technique. Location, upstate New York. Y-4337.

Engineers. (*a*) Chief Bridge Engineer, 30–50, with at least 10 years' highway bridge experience, to supervise engineering staff of consulting firm. Salary, $8,000–$10,000 a year plus bonus. (*b*) Design Engineer with general highway and bridge experience, including traffic interchange, clover-leaf access points, etc., to do planning, design and layout of highway structures and roads. Salary, $4,200–$5,400 a year, plus bonus. Location, South. Y-4351.

Assistant to President, preferably civil graduate, with some background in the construction field and ability to assist in the management of a large company in this type of work. Salary, $15,000–$20,000 a year, plus share of profits. Location, East. Y-4489.

Civil or Mechanical Engineer with New York State Professional Engineer's license and 5 years' experience covering plant engineering studies, surveys and reports to analyze and evaluate operating procedures covering trucking, materials handling, maintenance, cost reduction, etc. Must be resident of New York City. Salary, $5,160–$5,400 a year. Y-4535.

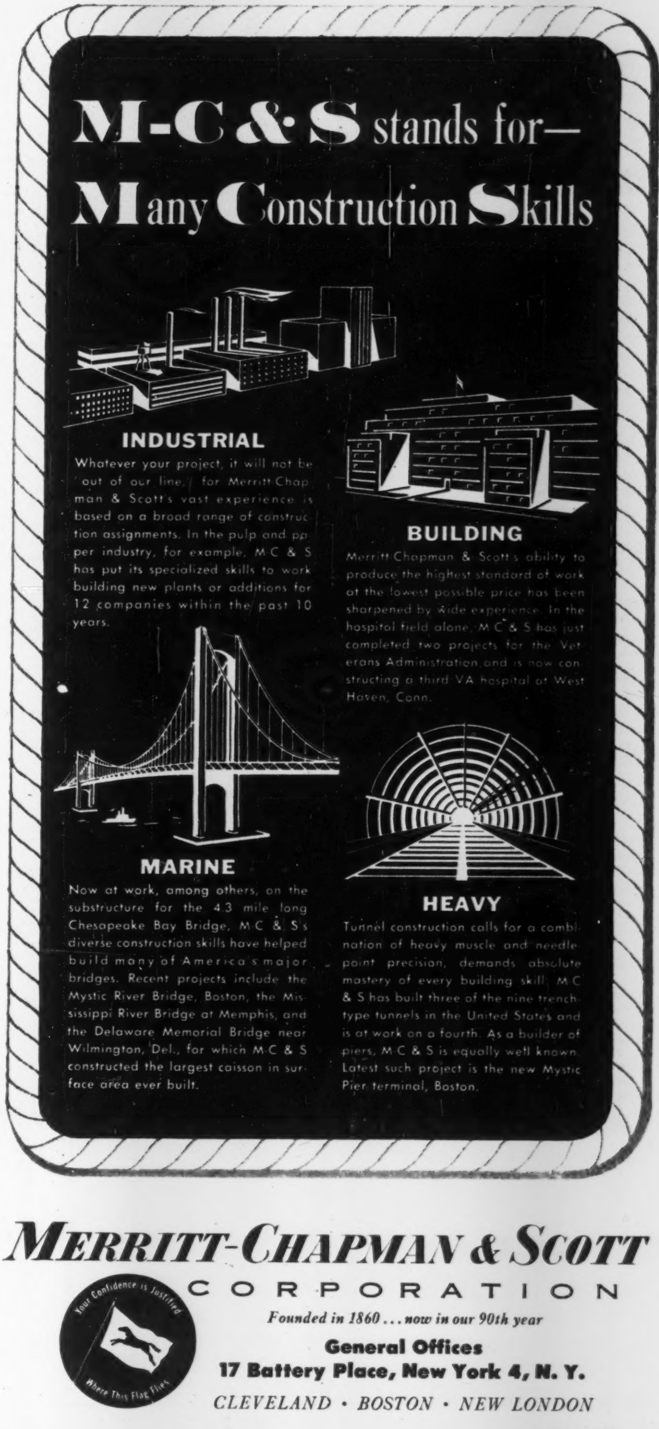
Structural Designer, 35–40, with 10 to 15 years' experience in structural steel and concrete, preferably with refinery experience. Salary, $6,000 a year. Location, northern New Jersey. Y-4546.

Engineers. (*b*) Construction Engineer, degree in civil engineering desirable, with 10 to 15 years' experience in construction supervision of steel and masonry buildings. Knowledge of plumbing, lighting, flooring, etc. Will supervise the contractors' work. Duration, about 2 years. (*c*) Junior Sanitary Engineer, recent graduate in civil engineering with a major in sanitary engineering desired. Will survey and study all wastes coming into the industrial waste system, with the object to remove them wherever they may be eliminated. Location, New York State. Y-4564.

Sanitary and Hydraulic Engineer with at least 10 years' experience in the designing of sewage and water systems, sewage treatment plants, water treatment plants, reservoirs, dams and miscellaneous sanitary and hydraulic municipal projects. Work also includes investigations, studies and reports for consulting firm. Location, Massachusetts. Y-4579.

Civil or Mechanical Engineer, graduate, with broad experience in design and preparation of plans and specifications for industrial facilities, utility systems and airfields. Will assist in the supervision of architect-engineer contracts for military construction and will involve review of plans for conformance with established design criteria and directives. Must be qualified to deal with representatives of military establishments and architect-engineer firms concerned with the various projects. Salary, $5,400–$6,400 a year. Location, Washington, D.C. Y-4652(*a*).

Materials Cataloging Engineer, 30–45, with 5 years' experience required in materials handling, stores or inventory control work. Knowledge of oil field equipment of broad nature. Cataloging and writing definitions. Duties: identifying, writing definitions, and cataloging all types of oil field equipment and accessories. For a consultant. Salary, $7,200 a year. Location, Chicago, Ill. Some foreign traveling. R-7152(*a*).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BUILDING

Merritt-Chapman & Scott's ability to produce the highest standard of work at the lowest possible price has been sharpened by wide experience. In the hospital field alone, M-C & S has just completed two projects for the Veterans Administration and is now constructing a third VA hospital at West Haven, Conn.

MARINE

Now at work, among others, on the substructure for the 4.3 mile long Chesapeake Bay Bridge, M-C & S's diverse construction skills have helped build many of America's major bridges. Recent projects include the Mystic River Bridge, Boston, the Mississippi River Bridge at Memphis, and the Delaware Memorial Bridge near Wilmington, Del., for which M-C & S constructed the largest caisson in surface area ever built.

HEAVY

Tunnel construction calls for a combination of heavy muscle and needlepoint precision, demands absolute mastery of every building skill. M-C & S has built three of the nine trench-type tunnels in the United States and is at work on a fourth. As a builder of piers, M-C & S is equally well known. Latest such project is the new Mystic Pier terminal, Boston.

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NEWS OF Engineers

ASCE President Ernest E. Howard, consulting engineer of Kansas City, Mo., was recently initiated into the University of Texas chapter of Chi Epsilon, honorary engineering fraternity, as honorary member. **Sydney Wilmot,** manager of ASCE Technical Publications, New York, N. Y., was recently initiated into the Manhattan College chapter as honorary member. **Harold Larsen,** editor, ASCE Technical Publications, New York City, has been appointed to the newly created post of councillor-at-large. **Robert Moorman,** professor of civil engineering, University of Missouri, has been elected councillor from the central district and **John B. Babcock,** professor of railway engineering, Massachusetts Institute of Technology, has been named national vice-president and councillor from the new southeast district.

C. E. Bischoff, for the past two years construction engineer for the Franklin County (Ohio) engineering department at Columbus, has been appointed chief deputy there.

Sidney J. Williams, assistant to the president, National Safety Council, was recently named the Beecroft Memorial Lecturer by the Society of Automotive Engineers, for his "substantial contributions to the safety of traffic involving motor vehicles."

Frank Kerekes, assistant dean of the division of engineering and professor of civil engineering at Iowa State College, has been appointed chairman of the Standard Building Code Committee of the American Concrete Institute.

Richard R. Lyman, consulting engineer of Salt Lake City, Utah, was honored on his recent eightieth birthday by the Sons of Utah Pioneers in its publication, "The Pioneer" as one of the state's most distinguished citizens. An authority in water supply engineering, Dr. Lyman has served on the Board of Consulting Engineers for the Sanitary District of Chicago and was one of the three original consulting engineers to the Metropolitan Water District of Southern California on its vast project for bringing Colorado River water to Los Angeles.

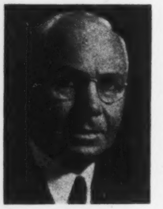
Carl T. Baer, formerly design engineer for the Public Works Department of Dallas, Tex., has been appointed executive assistant to coordinate the work of the engineering division.

G. Brooks Earnest

ASCE Director G. Brooks Earnest, since 1948 professor of engineering surveying at Case Institute of Technology, has been named dean of the engineering school at Fenn College, Cleveland, Ohio. In addition to his teaching duties during the recent war, Professor Earnest was executive secretary to the president at Case, assisting in the development of the Navy's V-12 program. He has been a member of the Society's Surveying and Mapping Division and the Committee on Student Chapters.

Paul Rogers, structural design engineer, Sargent & Lundy, of Chicago, Ill., was awarded second place in the recent Western Society of Engineers technical paper competition for his paper, "The Structural Aspects of Power Plant Design."

Edmund Schulz, hydraulic engineer for the Bureau of Reclamation, at Boulder City, Nev., is on leave from his duties there to continue research work in sedimentation at Colorado A. & M. College, at Fort Collins, Colo.


John L. Savage

John L. Savage, for many years chief designing engineer for the Bureau of Reclamation, has been appointed by President Truman to the twelve-member board for carrying out the Point Four Program. The board, which is headed by Nelson A. Rockefeller, will launch a program for "development of backward areas as an important means of working for ultimate peace and security in the world." Mr. Savage was instrumental in the design of Hoover and Grand Coulee dams and has served as consulting engineer to several foreign governments.

Charles W. Bryan, Jr., president of the Pullman-Standard Car Manufacturing Co., Chicago, Ill., has been elected to the board of directors of the American Standards Association for the term 1951–1954.

Henry M. Shank, of Ogden, Utah, has become assistant regional forester in charge of the engineering division of the U.S. Forest Service, at Denver, Colo., succeeding **Carl A. Gould,** who has retired after 19 years of service.

Theodore von Karman, Hon. M. ASCE, chairman of the Scientific Advisory Board at U.S. Air Forces Headquarters, Washington, D.C., has been awarded the Kelvin Gold Medal for 1950. He is the second American to receive the medal. A world-renowned aerodynamicist and long time adviser to the Air Forces, Dr. von Karman was for some years at California Institute of Technology as adviser to the Guggenheim Laboratory of Aeronautics and the Jet Propulsion Laboratory. Since 1944 he has been assisting and planning the long-range research program of the Air Forces. He formed the Scientific Advisory Group and was sent abroad during the war for a survey of technological developments. He became an Honorary Member of ASCE early this year.

Marcus F. H. Greenhorne and **Arthur J. O'Mara, Jr.,** of Washington, D.C., have formed an engineering practice in Hyattsville, Md., under the name of Greenhorne & O'Mara. They will specialize in land planning, surveys, storm drain, sewer and water design, and road design.

Charles O. Boynton, formerly structural engineer with the Foster Wheeler Corp., Houston, Tex., has joined the staff of Sverdrup & Parcel, Inc., St. Louis, as structural engineer in the San Francisco, Calif., office of the organization.

(*Continued on page 88*)

Houston Convention of ASCE
Hotel Rice, February 21–23, 1950

(*Please Print*)

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Rice Hotel
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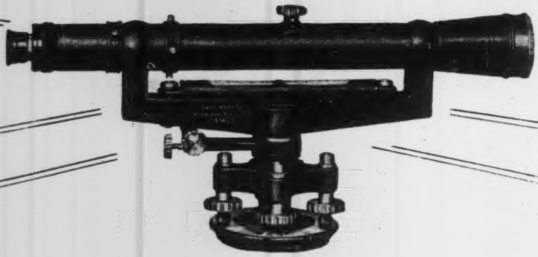

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Features	D. White No. 7080	Instrument A	Instrument B
Magnifying Power of Telescope	35X	30X	27X
Distance away you can read 1/100 ft. graduation	1200 ft.	1050 ft.	900 ft.
Diameter of objective lens	1.81 in.	1.485 in.	1.69 in.
Field of view (In minutes of arc)	64'	52'	60'
Coated optics	YES	YES	YES
Covered Leveling Screws	YES	YES	Y
Can you easily replace worn leveling screws in the field?	YES	NO	YES
Sensitivity of level vial (in seconds of arc per 2mm of graduation)	20"	20"	25"
Price — Complete with carrying case, tripod and accessories — F.O.B. factory	$245.00	higher	higher

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News of Engineers

(Continued from page 86)

Hugh M. Arnold, Lt. Col., Corps of Engineers, Department of Army, Washington, D.C., has been named district engineer at Tullahoma, Tenn.

R. E. Dougherty, Past-President of the Society and retired chief engineer and vice-president of the New York Central System, has been appointed engineering consultant on the Long Island Railroad investigations arising out of the recent wreck. Since Mr. Dougherty's retirement from the New York Central, he has served as consultant to the line and to numerous other organizations. In 1949 President Truman appointed him a member of the White House Renovation Committee. He has been active in Engineers Joint Council activities since inception of the organization.

R. E. Dougherty

William S. Walker, previously on the engineering staff of the Dravo Corp., Pittsburgh, Pa., is now associate professor of civil engineering at Michigan College of Mining and Technology, Houghton, Mich.

T. C. Fredrick, chief engineer for DeLeuw, Cather & Co., Chicago, Ill., consulting engineers, has gone to Bangkok, Thailand, to direct investigations for the rehabilitation of the Royal State Railways in that country.

Edmund R. Ricker has resigned as city traffic engineer of New Haven, Conn., to accept the position of traffic engineer with the New Jersey Turnpike Authority, with headquarters at Trenton.

W. W. Lauer, previously construction engineer with the Eichleay Corp., of Pittsburgh, Pa., has accepted the appointment of chief engineer of Foley Bros., Inc., Pleasantville, N.Y. In this capacity he will be working on the Foley Hermanos job for the Chile Exploration Co., at Chuquicamata.

W. W. Lauer

Harold E. Senf, since 1945 field engineer in the Portland Cement Association's West Virginia office, has been named manager of the Huntington, W.Va., plant of Criss & Shaver, Inc.

George O. Zalkind, project engineer with Gibbs & Hill, Inc., New York consulting engineers, has gone to Italy, where he will represent his firm on the construction of several power plants.

(Continued on page 90)

LIMITORQUE

THE MODERN OP[illegible]
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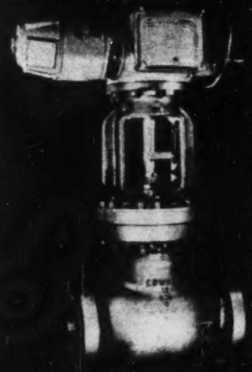
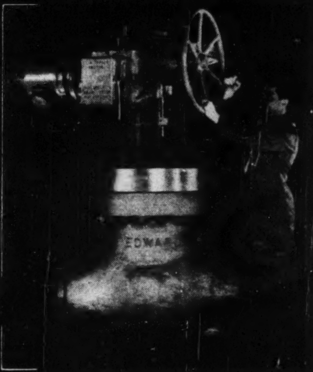
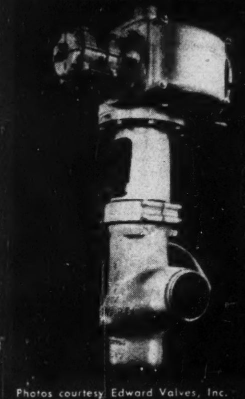
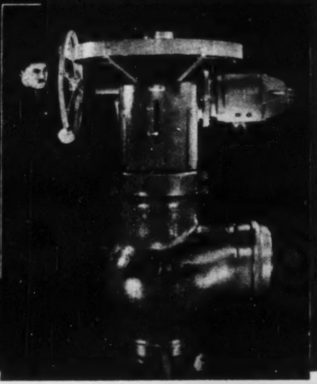
[illegible] IN VALVE [illegible]







Photos courtesy Edward Valves, Inc.



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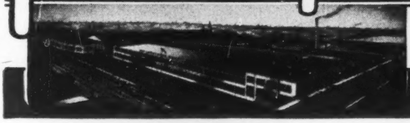

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News of Engineers

(Continued from page 88)

James U. Bragg has retired as superintendent of ways and structures for the Baltimore Transit Co., Baltimore, Md.

Rolf Eliassen, professor of sanitary engineering, Massachusetts Institute of Technology, is the fifth recipient of the George Westinghouse Award. He was cited for his "distinguished contributions as an engineering consultant to the government, as an inspiring and enthusiastic teacher, and as a director of the sanitary engineering program in one of America's foremost engineering colleges."

Courtland Steelman, for several years field project manager with the engineering department of E. I. du Pont de Nemours & Co., at Wilmington, Del., has been transferred to Louisville, Ky., where he will direct the construction of an addition to the company's Louisville Neoprene Works.

Sam Shulits has been appointed assistant professor of civil engineering at the Michigan College of Mining and Technology, Houghton, Mich. Formerly he was with the Bipartite Control Office, Frankfort, Germany, as deputy chief of the Plans and International Affairs Section of the transport group that administered the German federal transport system.

Fred Thieme

Fred Thieme has retired as assistant regional forester, U. S. Forest Service, at Missoula, Mont. Mr. Thieme has been in charge of engineering activities in the northern region for almost 30 years and has been engaged in government work for 39 years. In 1948 he was president of the Montana Section of the Society. He will be succeeded by Howard R. Jones, who has been serving in the Washington, D.C., office.

Merit P. White, acting head of the department of civil engineering at the University of Massachusetts, has been named director of the state Civilian Defense Organization committee, to study the protection of structures against bomb blasts. ASCE members appointed to the committee include **Vice-President Albert Haertlein,** of Harvard University, and **Albert G. H. Dietz** and **Robert Hansen,** of Massachusetts Institute of Technology.

James F. MacLaren Associates announce the opening of their consulting office at 705 Yonge Street, Toronto, Ontario, Canada.

Wilbur S. Hanna, district engineer for the U.S. Indian Service, at Billings, Mont., has retired after 45 years of service. For several years Mr. Hanna supervised irrigation projects between the Great Lakes and the Pacific Coast. He will be retained as a member of the engineering department of the Yellowstone River Compact Commission.

M. Hirschthal and **Philip King** have formed an engineering partnership under the firm name of Hirschthal & King, with offices at 347 Madison Avenue, New York City.

J. C. Behrens has left Skidmore, Owings & Merrill, at Oak Ridge, Tenn., to enter the employ of the Chattanooga Housing Authority as assistant director for slum clearance and urban redevelopment. He will be engaged in planning and programming the work under Title I of the Housing Act of 1949.

Robert A. Painter, who recently resigned as city engineer of Fredericksburg, Va., is now superintendent of maintenance and construction in the Fairfax County (Virginia) sanitary district office.

ASCE MEMBERSHIP AS OF DECEMBER 8, 1950

Members	7,756
Associate Members	9,985
Junior Members	13,220
Affiliates	68
Honorary Members	39
Fellows	1
Total	31,069
(December 9, 1949	27,649)

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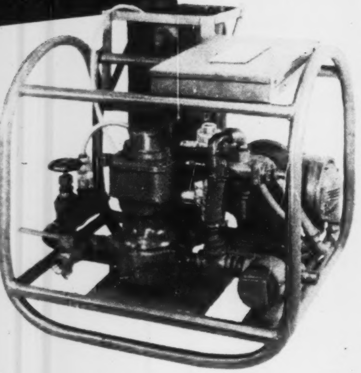
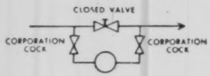
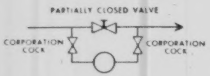
A New PORTABLE Unit
FOR FLOW-PROPORTIONAL CHLORINATION AND MAIN STERILIZATION





● for use in by-pass around closed gate valve to chlorinate heavily for main sterilization.



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%Proportioneers% new portable main sterilization unit is ready for work, any time, any place. Designed for emergency or general chlorination, this unit is light and compact — it can be easily carried wherever needed. It's a rugged, self-contained "package" — complete in every detail — including Chem-O-Feeder, Treet-O-Control meter, and chlorine solution tank with inter-connecting piping.

You don't need electricity or other outside power for this unit — it operates hydraulically, driven by the main line pressure. Chemical feeding is automatically maintained in exact proportion to the flow through the main, with feeding rates adjustable up to 5 gals. per hr. at pressures from 15 to 100 p.s.i.

Municipalities, contractors and consulting engineers have put the stamp of approval on this new water treating unit. For complete information, write %Proportioneers, Inc.% 360 Harris Ave., Providence 1, Rhode Island.

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Recent BOOKS

American Society for Testing Materials, Proceedings, Vol. 49, 1949

Technical committee reports concerning ASTM Standards and technical papers presented at society meetings, covering a wide range of topics such as metals, cement, soils, plastics, and dielectric materials, are contained in this annual 1,240-page publication. The table of contents and subject and author indexes cover also material published in the ASTM Bulletin and the Special Technical Publications Symposiums. Cloth bound editions sell for $12 and the half leather for $14. American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa., 1950.

ASTM Standards on Cement

Standard and tentative specifications, methods of chemical analysis, and methods of physical testing pertaining to cement, as well as information on air-entraining, blast-furnace slag, Portland, natural and masonry cements are presented by the ASTM Committee C-1 on Cement, Specifications, Chemical Analysis, Physical Tests in this publication. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1950, this illustrated 219-page book sells for $2.

Civil Engineering Drawings, Specifications and Quantities

Representing current practice in England, F. J. Crabb's revised edition of J. M. Rodger's *Civil Engineering Drawings, Specifications and Quantities*, describes the preliminary work on civil engineering contracts and the drawings required for engineering works in general. The laws of contracts so far as they affect engineers and contractors are summarized, and a complete set of conditions of contract followed by typical specification clauses is included. (Ernest Benn Ltd., London, E.C. 4, 1949, 264 pages, 25*s*.)

Civil Engineering Handbook

The third edition of L. C. Urquhart's comprehensive work, *Civil Engineering Handbook* contains essential theory and standards, practice and data to meet the needs of civil engineers in solving specific problems. Sections on surveying, hydraulics, stresses and steel design, transportation, concrete, foundations, water supply and purification and sewage and sewage disposal have been expanded, and new material on photogrammetric surveying, airport engineering, and design of pavements for highways has been added. A bibliography accompanies each main section, and footnotes are included for special references. (McGraw-Hill Book Co., New York, Toronto, London, 1950. 1002 pages, $8.50.)

(A) Course of Reinforced Concrete Design

In the early chapters of *Reinforced Concrete Design* by T. J. Bray, brief consideration is given to concrete material and mixes as an introduction to the design information which constitutes the main subject matter. Chapters on loads, stresses, reinforcement, reinforced concrete structures, and specific types of structures such as foundations, walls, tanks, towers, and arches are included. This revised 1950 edition of 220 pages is published by Chapman & Hall Ltd., London, W.C. 2, and sells for 30*s*.

(The) Delaware and Hudson Canal

The history of the first engineering work in the United States that cost over a million dollars is related by E. D. Le Roy in *The Delaware and Hudson Canal*. Copies of the original plans and legislation pertaining to the canal, which was constructed to bring the anthracite coal of Pennsylvania to the eastern markets, are presented as well as pictures of the route, and descriptions of the engineering aspects. The Wayne County Historical Society of Honesdale, Pa., 1950, is publisher of this 95-page book which sells for $2.

Der Abfluss in Offenen Naturlichen Wasserlaufen

Investigation of the flow of water in nature and application of the results to irrigation problems is discussed by A. van Rinsum in *Der Abfluss in Offenen Naturlichen Wasserlaufen*. Equations applying to natural and artificial flow of water are presented, in addition to various concepts which are illustrated in detail by sketches, graphs and tables. (Verlag von Wilhelm Ernst & Sohn, Berlin, 1950, 80 pages, 7.50 *D.M.*)

Engineering Economy

Thorough consideration of economic as well as technical aspects in the solution of engineering problems is stressed throughout H. G. Thuesen's book, *Engineering Economy*. To this end several chapters deal with the basic mathematical factors, the treatment of estimates, various kinds of costs and accounting methods, bases for comparison of alternatives, evaluation of replacements, economy of operations, utilization of personnel, and the application of engineering economy studies to public activities. (Prentice-Hall, New York, 1950, 501 pages, $6.65.)

(*Continued on page 94*)

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Mechanical Joint features are: Ease and speed of installation, construction economy, joint deflection, leak-tight, long life. Used with AWWA Class A, B, C, D; Federal Spec. WW-P-421; or Class 100, 150, 200, 250, centrifugal pipe.

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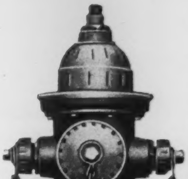

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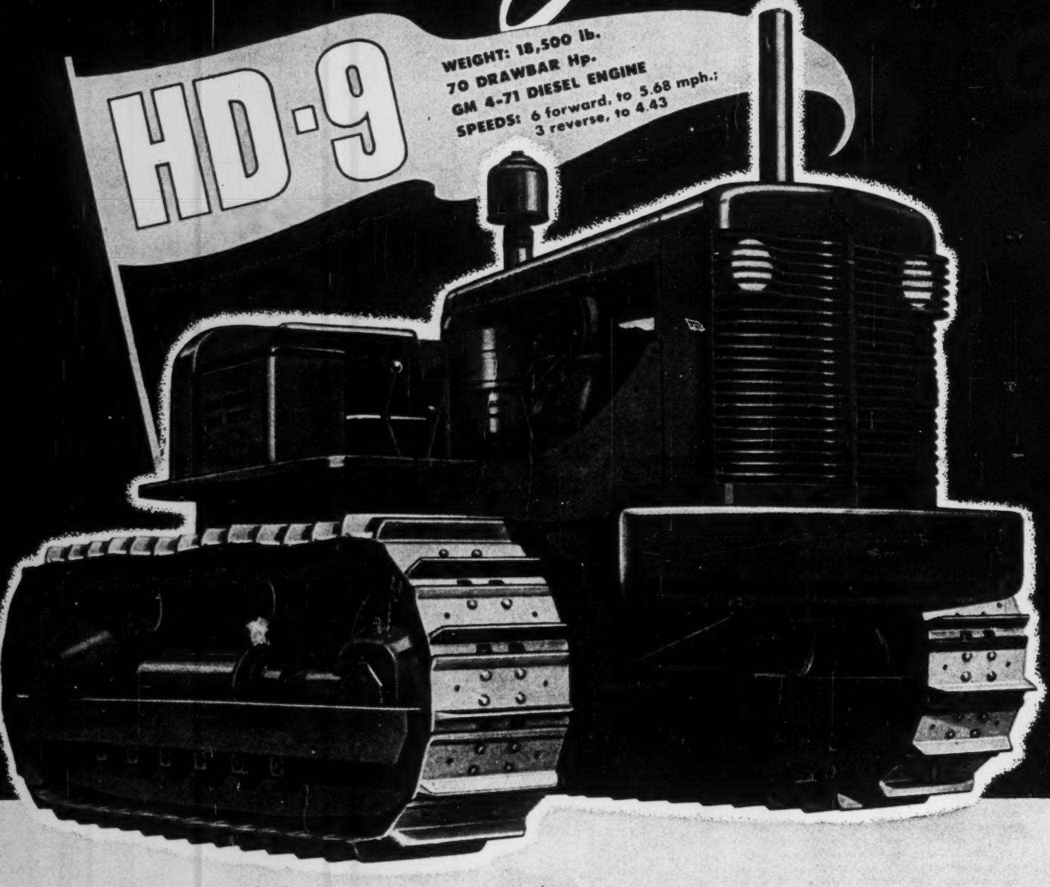
HD-9
WEIGHT: 18,500 lb.
70 DRAWBAR Hp.
GM 4-71 DIESEL ENGINE
SPEEDS: 6 forward, to 5.68 mph.;
3 reverse, to 4.43

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NEW POWER RATING

POWER, WEIGHT, BALANCE put them in a class of their own — never such traction . . . such pulling, pushing or lifting ability. And the smooth-operating GM 2-Cycle Diesel engines work without strain under the most extreme conditions.

NEW STRENGTH

All parts are designed and built to carry their loads with a margin of safety. No need to go to a larger tractor just for strength alone. The HD-9 and HD-15 set new standards for tractor quality.

- ✓ For Greater Production
- ✓ For Easier Operation
- ✓ For Simplified Servicing

NEW DESIGN SIMPLICITY . . .

for Easier Control and Greater Operator Comfort—Easy-shift transmission • Self-energizing brakes • Booster steering controls • Adjustable, cushioned seat • Wide arm rests • Convenient controls and pedals • Full visibility • Instant electric starting.

for Simplified Servicing—Unit construction permits removing major assemblies without disturbing companion groups • Extended lubrication periods throughout—1,000 hours on truck wheels, idlers and support rollers.

Complete Line of Matched Equipment, Developed in Cooperation With Allied Manufacturers, Available For Both The HD-9 and HD-15.

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WEIGHT: 27,500 lb.
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GM 6-71 DIESEL ENGINE
SPEEDS: 6 forward, to 5.80 mph.
3 reverse, to 4.51

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Recent Books

(*Continued from page 91*)

Engineering Hydraulics

Written by selected authorities and edited by Hunter Rouse, M. ASCE, *Engineering Hydraulics* constitutes the official proceedings of the Fourth Hydraulics Conference of the Iowa Institute of Hydraulic Research, held in 1949. Fundamental principles are emphasized throughout the book, which deals with the principles of flow, hydraulic similitude, flow measurement, hydrology, flow of underground water, steady and unsteady flow in closed and open systems, flood routing, wave motion, sediment transportation, and hydraulic machinery. A list of symbols, dimensional considerations, and the properties of common fluids are found in the appendix. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1950. 1039 pages, $15.)

(The) Friction and Lubrication of Solids

An experimental study of the physical and, to a lesser extent, of the chemical processes that occur during the sliding of solids is described in this monograph, *The Friction and Lubrication of Solids* which gives special attention to metals. Since the subject matter deals almost entirely with experimental research, it cannot be considered a general textbook. However, the authors, F. P. Bowden and D. Tabor, do cover a number of the physical properties of solid surfaces. (Oxford University Press, New York; Clarendon Press, Oxford, England, 1950. 337 pages, $7.

Geology and Foundation Treatment

Discussion of the general geology of the Tennessee Valley area, integration of the work of engineers and engineering geologists, choice of the dam site and remedial measures in the treatment of foundations for dams and appurtenant structures throughout the valley are presented, in Technical Report No. 22, of the Tennessee Valley Authority entitled *Geology and Foundation Treatment*. The appendixes include a detailed presentation of the leakage problem at Great Falls Dam in the Cumberland River Basin and summary of quarry and river aggregate investigations in the TVA construction program. This 548-page book may be obtained from the U.S. Government Printing Office, Washington, D.C. 1949, for $2.

Hydrodynamics, a Study in Logic, Fact and Similitude

G. Birkhoff treats two special aspects of fluid mechanics. The complicated relation between theory and experiment is dealt with in chapters I and II by an examination of the paradoxes of traditional hydrodynamics and a thorough consideration of "free boundary" theory. Chapters III–V are concerned with applications of symmetry concepts and provide a treatment of modeling and dimensional analysis and various applications of group-theoretic ideas to fluid mechanics. (Princeton University Press, Princeton, N.J., 1950. 186 pages, $3.50.)

Industrial Accident Prevention

Placing special emphasis on the human factor in safety work, full coverage from fundamentals through specific methods and devices to the setting up and carrying out of full-scale safety programs is offered by H. W. Heinrich in *Industrial Accident Prevention*. New chapters on motor-vehicle fleets, supervision, personal protective devices, and short-form safety course are included in this third edition. Material has been added also to the sections on accident hazards and production faults, supervisory control of employee performance, and causes analysis of boiler machinery accidents. McGraw-Hill Book Co., New York, 1950. 470 pages, $5.

Lehrbuch fur Betonbauer

Designed as a text for concrete engineering students and apprentices, this volume by H. Rietli considers the characteristics and behavior of various concrete materials. It includes discussion of such topics as the composition of concrete, basic constituents and binding materials, properties and behavior of concrete under external influences, and the production and treatment of cement. (Verlag von Wilheim Ernst & Sohn, Berlin, 1950. 89 pages, 4.80 D.M.)

Recent Books

Procedure Handbook of Arc Welding Design and Practice

In the ninth edition of the *Procedure Handbook of Arc Welding Design and Practice*, the data have been reorganized and consolidated to retain all currently useful material from the previous editions and to include new material. The main section headings include processes, equipment and nomenclature; weldability of metals; techniques, procedures, speeds, and costs for welding mild steel; basic design for welded construction; design of arc-welded structures; and miscellaneous applications of arc-welding in manufacture, construction, and maintenance. (Lincoln Electric Co., Cleveland, Ohio, 1950, 1,200 pages, $2 in U.S.A.; $2.50 foreign.)

Railway Track

Of value as a text to students and as a reference manual for railway track specialists, K. F. Antia's work, *Railway Track*, now in its second edition, considers various aspects of the subject with emphasis on methods practiced in India. It is divided into four parts, dealing respectively with materials, design and layout; construction, maintenance and renewal; related topics such as bridge maintenance and signalling and interlocking; and technical data appendixes. (The New Book Co., Ltd., 188–90 Hornby Road, Bombay, India, 1949. 416 pages.)

Snow Melting

A comprehensive coverage of all phases of the use of embedded hot water coils for melting snow on roads, driveways and sidewalks is presented in *Snow Melting* by T. N. Adlam. Different types of systems, the calculation of pipe sizes and spacing, data on snowfall in the United States, Alaska and Canada, design details, anti-freeze solutions, installation techniques, and installing and operating costs are covered. (Industrial Press, New York, 1950. 224 pages, $4.50.)

Structural Shop Drafting

Intended for use as a text for structural draftsmen, Volume I of *Structural Shop Drafting* covers the "beam-and-column" types of fabrication found in office buildings, hotels, apartments, hospitals schools and similar structures. Basic drawing information precedes the main text which is further supplemented with problems and exercises for student solution. (The American Institute of Steel Construction, 101 Park Ave., New York 17, N.Y., 1950. 173 pages, $3.)

Structural Plastics

Of value to structural engineers, designers and fabricators, this book by H. C. Engel, C. B. Hemming, and H. R. Merriman covers the structural characteristics of plastics. It contains carefully selected theoretical and practical information on their nature, properties and utilization; summarizes researches in the field; and discusses many factors involved in the design and fabrication of plastic structures. (McGraw-Hill Book Co., New York, Toronto, London, 1950, 301 pages, $4.50.)

Symposium on Use of Pozzolanic Materials in Mortars and Concrete

Special Technical Publication No. 99 of the ASTM, entitled *Symposium on Use of Pozzolanic Materials in Mortars and Concretes*, presents various general and specialized aspects of the subject in nine papers. Included are the use of pozzolans in mass concrete, mortars, etc.; the effect of calcination on natural pozzolans; and the use of pozzolans for counteracting undesirable features of the alkali-aggregate reaction in cement. (American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1950. 203 pages, $2.50.)

Traffic Engineering Handbook

For those responsible for originating or passing upon the technical study and solution of traffic and transportation problems, the second edition of

(*Continued on page 98*)

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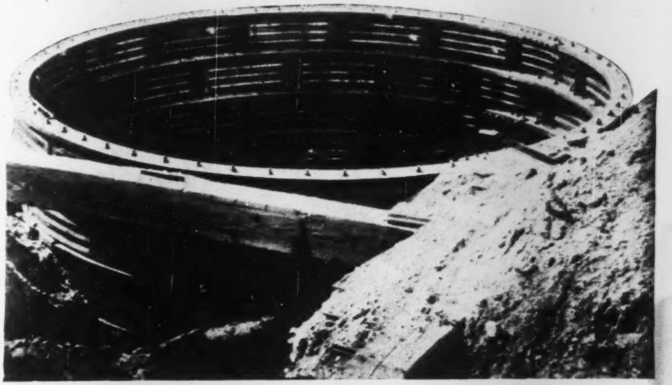

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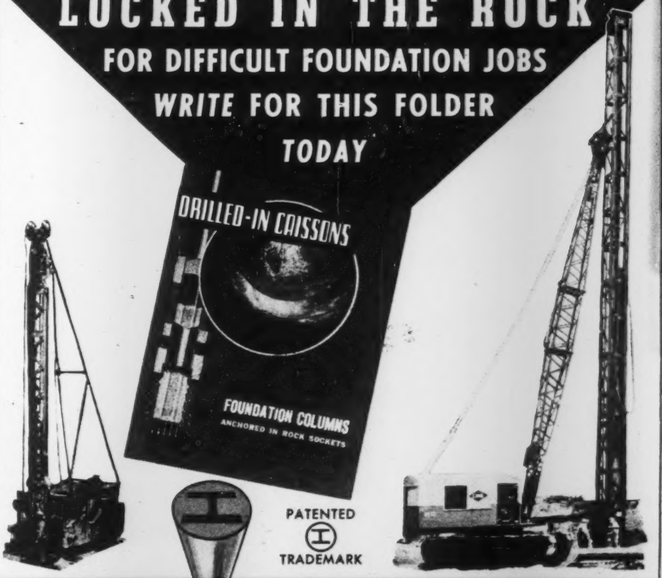

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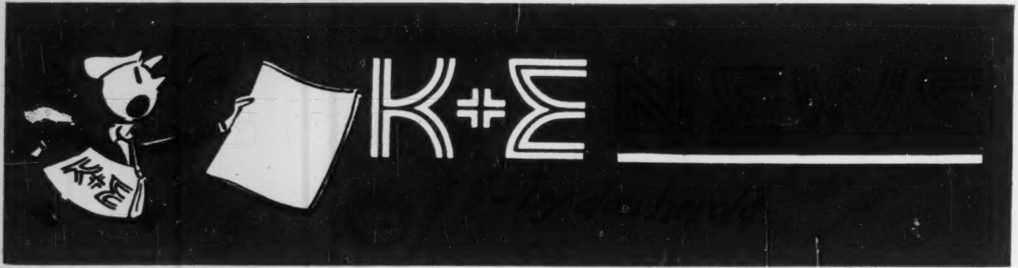

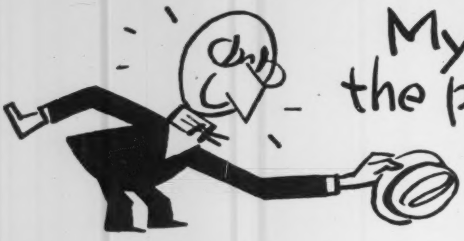

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At Keuffel & Esser precision and quality are almost a century plant. In other words they have been growing there in fertile soil for exactly 83 years. (K&E was founded in 1867.)

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Precision in the Air

I've been talking about K&E products for a long, long time. Maybe it's time I talked a little about the people behind them.

I've just been through the K&E factory at Hoboken again. I wish you could have been along, because you, as an engineer, would have seen much more than I. But even I could sense the honest craftsmanship and the father-and-son tradition of precision and the zeal for quality in the air.

You just don't get to be that fine in one generation.

There are a number of K&E employees who have been around for about a half a century, and there are some 150 employees who have been there for a quarter of a century or more. This latter bunch of kids, as well as the young sprouts who have been there only 20 or 15 years, have inherited the K&E feeling for doing things the good, old, exciting, honest way.

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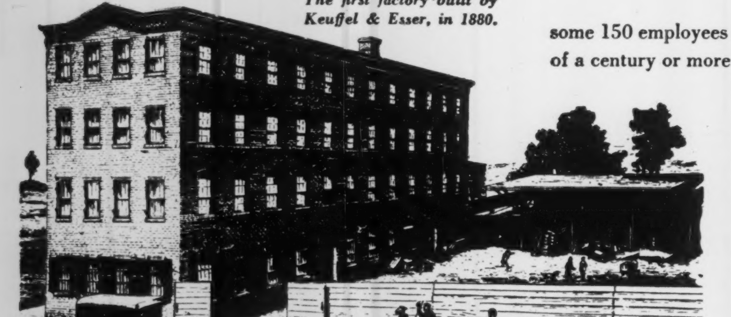

MOST K&E WORKERS MUST HAVE CUT THEIR TEETH ON K&E SLIDE RULES

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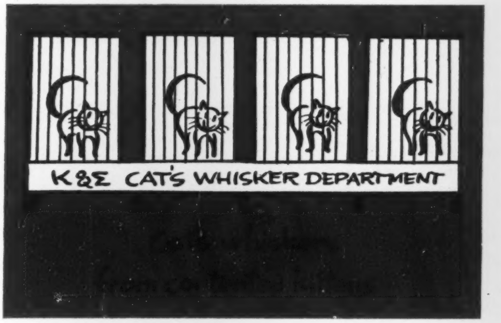
When K&E coined the phrase "Partners in Creating," they of course meant not themselves but their products. And it's true that K&E products have been in with engineers, scientists, draftsmen and architects on the creation of most of the big man-built wonders of the world for over 4/5 of a century.

The K&E trade mark for decades, and the more modern one adopted in recent years.

Zippy at 83

K&E have remained alert and alive, as is evidenced by their unending originality and inventiveness. They made America's first slide rules, as far back as 1891. And in both world wars, they did a big development job on optical equipment for our fighting men—on vital things such as periscopes, fire control instruments and height finders. The K&E catalog is full of "firsts"—some of them plenty recent, such as Wyteface* Measuring Tapes and Leroy† Lettering Equipment. No wonder it's the engineers' encyclopedia.



Factories within a Factory

K&E headquarters are a town within a town, many factories within a factory. In one area they're coating miles of papers and cloths. In another they're turning screws so tiny you feel like a hippopotamus if you try to pick one up. Here they're grinding optical lenses.

Gee, there are a lot of FIRSTS in this book!
K&E CATALOG

There they're putting graduations no bigger than a fly's kneecap on scales of some sort. Here they're doing fastidiously fine leather work. There they're reeling off steel measuring tapes by the mile.

K&E was in there, sighting, in World Wars I and II

But wherever you go you are aware of the age-old passion for precision and quality. And I'm not the least bit sorry that today I haven't sold you a single K&E product. I've just tried a little bit to sell you on the people at K&E—and to get you to believe that you can safely make K&E products trusted partners in your own creative work.

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This new edition contains 201 photographs, and drawings, a glossary of terms and a bibliography. **Price $10.00**

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Recent Books

(Continued from page 95)

Traffic Engineering Handbook, edited by H. K. Evans, will be a valuable reference. Published by Institute of Traffic Engineers, New Haven, Conn., the 514-page book is sold by the Association of Casualty and Surety Companies, Accident Prevention Department, 60 John St., New York 7, N.Y., 1950, for $6.

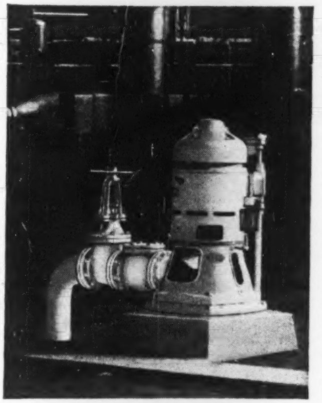
Positions Announced

U.S. Civil Service Commission. An examination for engineering positions (paying $4,600 and $5,400) at the Wright-Patterson Air Force Base and the 862nd Air Force Specialized Depot, Dayton, Ohio, has been announced by the U.S. Civil Service Commission. Full information and application forms may be secured from local post offices, civil service regional offices, or the U.S. Civil Service Commission, Washington 25, D.C. File applications with the Executive Secretary, Board of U.S. Civil Service Examiners, Wright-Patterson Air Force Base, Dayton, Ohio.

State Planning Commission, Maryland. The Maryland State Planning Commission has immediate openings for the positions of site planner, salary $5,175–$5,625 per annum; Planning Engineer I, salary $6,000 per annum; and Planning Engineer II, salary $3,840–$4,800 per annum. For complete information write to the State Employment Commissioner, 31 Light Street, Baltimore 2, Md.

Department of Air Force, Washington, D.C. Vacancies in the U.S. Air Force Headquarters, Washington, D.C., for civil engineers possessing photo interpretation experience or potential, include Photo Intelligence Specialists, GS-9 ($4,600 per annum, starting salary) through GS-12 ($6,400 per annum, starting salary). Inquiries regarding these positions and requests for civil service application forms should be made to the Photo Intelligence Section, Reconnaissance Branch, Directorate of Intelligence, Headquarters, United States Air Force, Washington, D.C.

U.S. Civil Service Commission. The U.S. Civil Service Commission has announced an examination for Highway Engineer (Trainee) to fill positions paying $2,875 and $3,100 a year in various federal agencies, particularly the Bureau of Public Roads. For the $2,875 positions (Grade GS-4), appointment is restricted to college juniors who will have completed three-fourths of the curriculum leading to the bachelor's degree in civil engineering by June 30, 1951, and who intend to return to school to complete their undergraduate training after employment during the summer months. For the $3,100 positions (GS-5), appropriate civil engineering experience or a combination of such experience and education will be accepted as qualifying. Applications will be accepted, not later than February 6, 1951, from students who expect to complete the required courses not later than June 30, 1951. Applications may be obtained from the U.S. Civil Service Commission, Washington 25, D.C.



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Meetings and Conferences

Chi Epsilon. Regular meetings of the New York alumni chapter of Chi Epsilon will be held on the third Wednesday of each month. The group gathers at the service dining room of the New York Times Building on 43rd Street. Similar meetings are being held regularly by the Los Angeles alumni.

Associated Equipment Distributors. Headquarters for the 32nd annual meeting of the Associated Equipment Distributors will be the Stevens Hotel, Chicago, Ill., January 28–February 1.

American Institute of Electrical Engineers. An expanded program of professional and social activities will feature the Winter General Meeting of the AIEE, to be held at the Hotel Statler in New York, January 22-26.

International Heating and Ventilating Exposition. Under the auspices of the American Society of Heating and Ventilating Engineers, the International Heating and Ventilating Exposition is to take place at the Commercial Museum, Philadelphia, Pa., January 22–26.

Second Industry-College Conference. "The Engineer and National Security" will be discussed during the Second Industry-College Conference at Case Institute of Technology, Cleveland, Ohio, January 20.

Third California Conference on Street and Highway Problems. The Third California Conference on Street and Highway Problems, presented by the Institute of Transportation and Traffic Engineering of the University of California, is scheduled for January 24–26 on the Berkeley campus of the university.

Society of Plastics Engineers, Inc. The seventh annual national technical conference of the Society of Plastics Engineers, Inc., will take place at the Hotel Statler, New York City, January 18–20.

University of Louvain Requests Technical Books

Funds for technical books for the Library of the University of Louvain in Belgium are being asked by CARE. Pointing out that most of the books in the library were destroyed during the war, the organization notes especially the need for technical books in English.

CARE recalls the fact that the carillon and clock in the library tower at Louvain were donated by United States engineering societies, including ASCE, as a memorial to American engineers who died in the first World War, and notes that the famous chimes and a commemorative inscription "have endured the fire and bombing of this war."

Donations for books to the Louvain Library can be channeled through the CARE-UNESCO Book Fund, 20 Broad Street, New York 5, N.Y. A bookplate inscribed with the name of the contributing organization will be included with all gifts of $10 or more.

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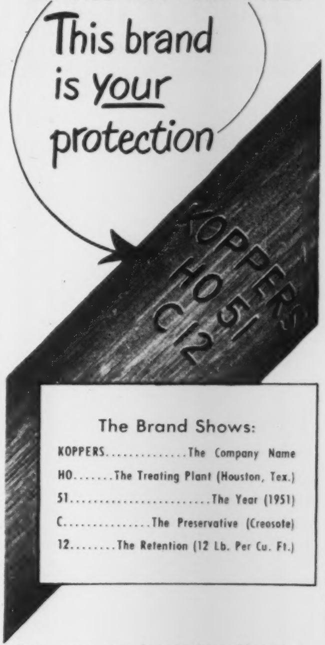
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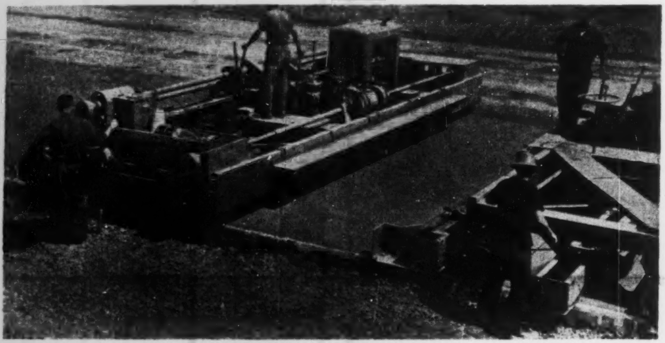
The screw-screed concrete spreader which is available in two models (10 to 15 ft width and 20 to 25 ft width), combines a transverse, 12-in. oscillating screed with the Jaeger remixing-compacting screw spreader. It offers the triple function of spreading, initial strikeoff, and precision metering of concrete for the following finisher. Its advantages are: remixing and compacting of concrete on the subgrade by the spreading screw completely eliminates honeycombing and segregation; spreads stiffest mixtures and biggest piles uniformly from form to form; and strike-off plate, immediately behind the screw, makes initial strikeoff to approximate grade line, then the 12" oscillating screed makes precision strikeoff and meters exactly right amount of material to the following finisher. Also costly carryback by shovelers is eliminated, as well as costlier delays of backtracking the paver. Any unusual deficiencies of material can be immediately seen and corrected. With no deficiencies or excesses of material, finisher can work farther back from the spreader, permitting concrete to condition properly. The finisher works with just right roll of material ahead of its screeds and uniform compaction under those screeds is assured. This screw-screed spreader and Jaeger's Type-X diagonal screed finisher are said to form a "three-screed paving team" capable of handling full output of the largest pavers, with big savings of equipment, time and labor. The team—with spreading, initial strikeoff and precision metering accomplished by the first unit, and transverse and diagonal screed finishing by the second—is claimed to eliminate the need for a second finisher on high speed paving. Both models offer easy 5-ft adjustability in 6-in. stages. Spreading screw on the 10 to 15-ft model is instantly reversible for spreading material toward either side form. On the 20 to 25-ft model, the screw is divided and permits spreading from center to side forms, side forms to center, or toward either side with both halves of the screw operating in the same direction. Directional control of the screws is instantaneous. On both models, the oscillating metering screed is Jaeger's single-lever quick-crown-change type, hydraulically lifted and with spring cushioned action. Address requests for Catalog CSS-O to **The Jaeger Machine Co., Columbus 16, O.**



Available in Two Models

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A twin shaft mixer which incorporates an advanced patented principle of attaching sectionalized lining for easier and more economical replacement has just been announced. The lining surface of the mixer, consists of several smaller sections, bolted to the heavy welded steel body from the outside. An additional feature of the Standard Mixer is that roller bearings are employed in place of sleeve bearings thereby greatly reducing the horsepower required for operation. The machine is available in 2 models. **Standard Steel Corp., Los Angeles, Calif.**

Experimental Layout Kit

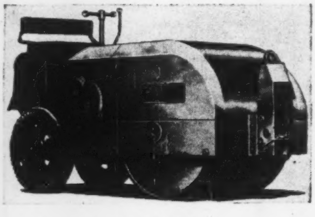
Designed to demonstrate the values obtained from 3-dimensional planning, a 200-piece kit of machines, benches, trucks, conveyors, materials-handling equipment, office and toilet equipment together with a 12 in. × 18 in. lucite planning board, columns and layout tape, is being introduced. The planning kit will not plan a specific plant, but will enable the user to test the merit of this type of planning before accepting or rejecting its values. **"Visual" Planning Equipment Co., Inc., Pennsylvania Ave. at River, Oakmont, Allegheny County, Pa.**

Compaction Apparatus

The Harvard Miniature compaction apparatus utilizes a novel method of soil compaction. Consistent moisture-density relationships closely duplicating field compaction curves can be developed in less time and with less effort and material than are possible by present procedures. Unit consists of a tamper, mold, collar remover, and sample ejector. **Soil Testing Services, Inc., 525 N. Noble St. Chicago 22, Ill.**

Concrete Mixer

Important improvements affecting both the design and performance of a new, heavy-duty type Model 16-S concrete mixer have been announced. In construction features, the 3-bag mixer is designed with heavier frame sections, coil spring mounting and cast steel drum heads having machined roller paths. Drum roller shafts revolve on larger, internal double row, self-aligning ball bearings mounted in pillow boxes attached to heavy trusses securely welded to the frame. In addition, the 27-hp gasoline engine comes equipped with a clutch and a spring loaded hoist clutch is kept in constant proper engagement to eliminate the need for frequent adjustments. Contact points on each end of the charging skip supporting bar are now provided for the selective skip shaker to produce a quick, positive vertical action for faster results. Other major changes incorporated include an improved water valve and lever arrangement and a positive Batchmeter actuating mechanism.



Model 16S

To facilitate field operation, the new model is quickly interchangeable to discharge either from side or end, depending on the best operating condition. As with the previous model, the Kwik-Mix tower loader attachment for loading trucks or depositing concrete at higher levels can be attached to the mixer as an optional unit. Standard equipment includes the characteristic Kwik-Mix flow line discharge chute, automotive type steering and the automatic and accurate water measuring system. **The Kwik-Mix Co., Port Washington, Wis.**

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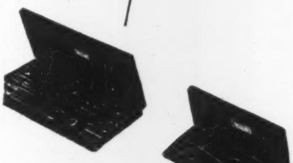

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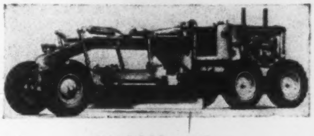
Equipment, Materials & Methods (Continued)

Motor Grader

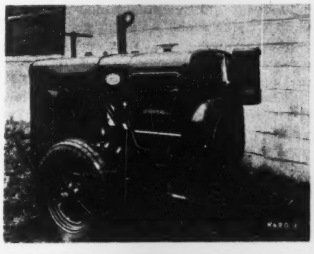
The No. 118 motor grader is of the extra heavy-duty class, and features a greatly improved transmission of the constant-mesh type. It has six overlapping forward speeds ranging from 1.3 to 22.6 mph and two reverse speeds—providing a satisfactory range for all work or travel requirements. An exceptionally high reverse speed of 10.5 is obtainable. This feature is especially desirable when restricted working conditions do not permit turning grader around. Only one lever is needed for the shifting of all gears, forward or reverse. Features include a 100 hp diesel engine; positive all-gear, four wheel tandem drive; full hydraulic control; and extra-rugged box-type single member frame, high-arched for maximum adjustment of blade. Also included as standard equipment are hand steering with hydraulic booster and large front tires same size as rear tires. Available, as extra equipment, is a hydraulic shiftable moldboard which permits a maximum extension of the blade 103 in. beyond rear tires with a 13 ft moldboard. Weight is from 23,560 lbs up depending upon extra equipment. **The Galion Iron Works & Mfg. Co., Galion, Ohio.**



Model No. 118

Wellpoint Pump

A wellpoint pump, small in size but big in capacity has been developed. It will give the capacity of many larger pumps, with the superior portability which results from its smaller size and lighter weight. This makes for easier handling on firm ground or in sticky, clinging mud or sand since it is mounted on two pneumatic tires allowing it to be towed at good speed from job to job. The Complete wellpoint pump fits all sizes and types of wellpoint systems and has a special outlet which may be used in jetting. It is powered by a Wisconsin air-cooled V.P. 4 gasoline engine. **Complete Machinery and Equipment Co., Inc., L. I. City, N.Y.**



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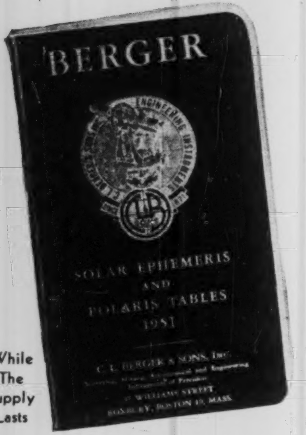
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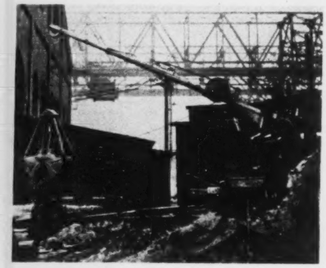
Equipment, Materials & Methods (Continued)

Hydrocrane

A HYDRAULIC CRANE, available in 2-ton and 3-ton sizes, has been used successfully in a variety of applications by a leading Chicago contractor. The crane was purchased principally for digging catch basins. For this work the contractor particularly wanted a rig that could operate well in close quarters. This crane dug an average of four basins per day, as well as the connections from the basin to the sewer.

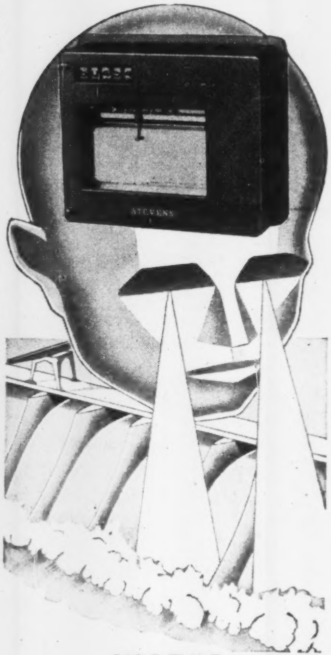


While working on a manhole excavation, this contractor had to drive sheet piling around the edges to prevent cave-ins. As an experiment, he attached an 1800-lb McKiernan-Terry hammer to the hydrocrane and found it worked excellently on pile driving. This saved the expense of renting a larger crane for the job, and the firm now bids on pile-driving jobs, giving them another source of income from the machine. The crane has also been used on septic tank jobs. It was used for the complete operation—excavation, tank setting, backfilling. Additional jobs include digging foundations, setting factory machinery and pre-cast pipe, erecting wooden roof trusses and I-beams, and loading pumps and compressors. **Bucyrus-Erie Co., South Milwaukee, Wis.**

BW Copyflex

DEVELOPMENT OF AN ENTIRELY NEW TYPE of office copying machine is announced. The machine named BW Copyflex, is the first one specifically designed to make low-cost direct positive copies anywhere in a business office. It is the answer to the need of modern business for a quick, clean method of privately making low-cost, errorproof copies anywhere in an office. It makes copies so fast, so neatly, and so easily that it eliminates much office paper work and for the first time makes possible the economy of "desk-side" copying without special operator training. The Copyflex accomplishes the entire copying process within itself. It needs no inks, tray developing, dark rooms, subdued or special lighting. It has no annoying fumes and does not require any "make ready," plumbing, or exhaust fans. No stencil, negative, or special training is required. In seconds, and without adjustment, the machine copies any size of

(*Continued on page 103*)



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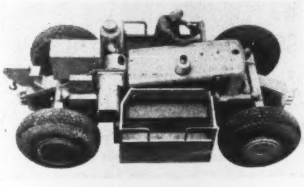
Equipment, Materials & Methods (Continued)

original matter up to $11^1/_2$ in. wide by any length. Copies are clean, smudge-proof, and exactly like the original matter, with the last copy as sharp and legible as the first in any quantity. The machine needs no installation. It can be placed anywhere in an office and is merely connected to the ordinary office electric light line carrying standard 60 cycles, 110 volt alternating current. It is only $29^1/_2$ in. wide, 28 in. deep, and 50 in. high, and is easily moved from room to room. **Charles Bruning Co., Inc., 100 Reade St., New York 13, N.Y.**

Tournatow

THE ELECTRIC DRIVE TOURNATOW is a machine with no clutch, no transmission, and no differential, and incorporates a new method of power transmission as used on heavy construction equipment. It solves the problem which limited the wide use of the electric automobile—no self-contained source of electric power. It uses its own diesel engine to generate its own power. Its alternating and direct current generators are driven by its diesel engine, and provide power for all steering, forward, reverse and lateral movements of the machine and for the winch operating through a patented fairlead. This self-generated current is conducted through electric wires to an electric motor and gear arrangement contained in the assembly of each of its four wheels. There are only four moving parts in each wheel—the pinion, 2 reduction gears and the internal gear within the wheel. The Tournatow incorporates proven features developed for the adapting of electric power control to heavy earthmoving equipment. It has demonstrated the value of its ability to use the smooth power and precision control of diesel electric equipment in the ground-handling of large aircraft. The effectiveness of its system of drive is attested to by the tremendous pull it can exert. In a recent demonstration the machine developed a pulling power sufficient to maneuver giant aircraft weighing approximately 400,000 lbs, which is more than sixteen times the weight of the Tournatow. **R. G. LeTourneau Inc., Peoria, Ill.**



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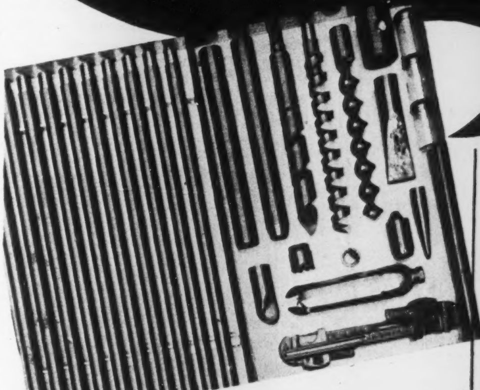

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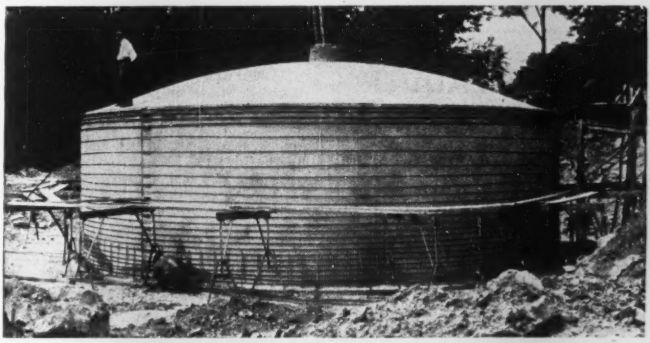

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The picture shows a partially completed 40′ diameter, 110,000 gallon pre-stressed "GUNITE" tank with a "GUNITE" dome roof, designed and built by us.

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At the present time, our organization is constructing several Pre-Stressed Tanks, without dome roofs, for use as digester tanks in sewage disposal works.

Many examples of Cement Gun Company's repair, remodeling and new construction work with "GUNITE" are pictured and described in Bulletin (B)2400. A request on your letterhead will bring your free copy by return mail.

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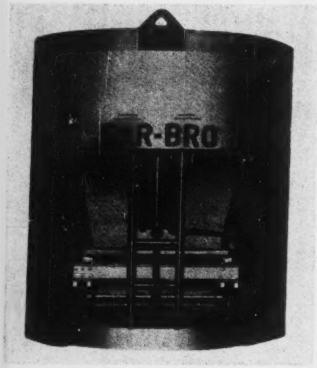
Equipment, Materials & Methods (Continued)

Concrete Bucket

A CONCRETE BUCKET with a high pressure air supply tank and control valves as an integral part of the equipment has been announced. Featured on the air-operated Model A bucket are pull-chain controlled valves that eliminate the necessity of hose, connectors and air supply at the dumping location. Double clamshell gates that are absolutely grout tight and positively non-clogging have center discharge and dump straight down. These air-operated gates provide positive control for releasing any portion up to a full load. They can be operated by remote control if desired. All sizes of Model A buckets, including the dual-4, two-compartment buckets, can now be equipped with high pressure air tanks and controls. Chutes and hoppers are made to fit the new air-operated buckets. **Gar-Bro Mfg. Co., 2416 E. 16th St., Los Angeles, Calif.**



Model A

Portable Roller

SEVERAL ADVANCEMENTS have been made in the variable weight portable roller. Steering is now done by hydraulic power under finger-tip control. A rugged spur gear final drive replaces the old chain drive, and a constant-mesh transmission eliminates gear-clashing and assures smooth gear-shifting. Other improvements are: easily adjusted Twin Disc, over-center, forward and reverse clutches; new design hydraulically operated towing hitch which folds back compactly against roller housing when not in use. The compaction effectiveness of the portable roller is said to equal that of a conventional 5–7 ton tandem roller. Compression under roll, without water ballast, is listed at 130 lbs per inch of roll width. With 2300 lbs of water added to the roll, compression is raised to 192 lbs per inch. The compression roll is unusually large for a portable roller—48 in. diameter by 42 in. wide. It is fitted with mats and sprinkler system. For information write **The Galion Iron Works & Mfg. Co., Galion, Ohio.**

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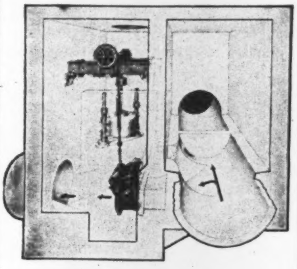
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Literature Available

VALVES—The 4-page Bulletin 1201 covering the Type AV combination air release and air inlet valve is announced. The folder describes the valve, offers charts, uses, dimensions and weights. **Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.**

WELLPOINT SYSTEM—A 76-page booklet on the Stang Wellpoint System is announced. Information is given on ground water hazards, and the planning of a wellpoint installation, as well as an explanation of exactly what the system consists of. The booklet contains many interesting illustrations. **John W. Stang Corp., 8221 Atlantic Ave., Bell, Calif.**

POWER SHOVELS AND CRANES—A colorful and heavily illustrated 12-page book, "Lorains on Pipeline Construction," features the application of Lorain power shovels and cranes to pipeline construction. Special attention is given to the Pipeliner, a specially designed hoe with wide gauge crawlers to straddle pipeline ditches. Application of other types of Lorain equipment such as clamshells, draglines and cranes is also depicted. The story of the use of rubber-tired Lorain motocranes for pipelining and how they can roll long distances quickly to widely separated spreads, is also included. **The Thew Shovel Company, Lorain, Ohio.**

PORTABLE LIGHTING SYSTEM—Bulletin 87-I describes a low-voltage portable lighting system for mining and construction work, known as the Joy-Lite. Driven by compressed air, it will develop an output of 250 to 280 watts (power to operate four high-powered sealed-beam flood or spot lights) with air consumption not exceeding 25 C.F.M. For protection from dirt and dripping water, the generator is mounted in a steel box which is equipped with a carrying handle for easy portability. Lamps have tripod swivel bases, which can be used as column clamps, and hooks which serve as hangers. The unit weighs 48 lbs. **Joy Manufacturing Co., Henry Oliver Bldg., Pittsburgh, Pa.**

PNEUMATIC WATER WORKS GAUGES—A bulletin on "Pneumatic Water Works Gauges" has been issued. Included in this four page bulletin, No. 285-G1, is a discussion of the features, description and operation of the pneumatic units. Also included is a discussion of the application of the devices to the summation of several flows. Illustrations are presented of both transmitting and receiving units as well as photographs of various types of indicating and recording dials and instruments. The back page of the bulletin shows a diagram of a typical filter control installation using pneumatic loss of head and rate of flow gauges. Under the description of the instruments, the bulletin discusses the several types of transmitters and receivers available and the principles on which the units work. **Builders-Providence, Inc., 345 Harris Avenue, Providence 1, R. I.**

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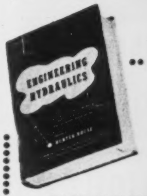

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Literature Available (Continued)

CRANE MOBILE—A 24-page catalog features machine design and job applications through the use of 74 illustrations. The CraneMobile which is available in 20 and 25 ton capacity is shown in the introduction. The inside picture of the powerful machinery assembly, followed by details of the gantry, pin-connected boom and jib is also included. A spread of pictures illustrates the specially designed CraneMobile carrier which is available in five models—6×4 and 6×6 drive with eight and nine ft overall width. The balance of the book illustrates the application of the CraneMobile on a wide variety of work. **Bay City Shovels, Inc., Bay City, Mich.**

PASSENGER ELEVATORS—"The Buyer's Guide for Passenger Elevators," will prove helpful to the consulting engineer, architect, or building manager planning the installation of passenger elevators. The 56-page booklet was compiled specifically to serve as a reference book on efficient vertical transportation in office buildings, hotels, department stores, apartment houses, and other public buildings. The information in this booklet is comprehensive and is presented with the help of numerous pictures, diagrams, curves, tables, and case examples. For a copy of Booklet B-4572, write **Mr. E. B. Dawson, Elevator Division, Westinghouse Electric Corp., Jersey City, N. J.**

CRANE AND DRAGLINE—The Model 3900 long-reach crane and dragline is described in a 12-page catalog just released. The bulletin lists complete working ranges and capacity tables, and explains how the added capacity claimed at long radii is obtained. Pictures and text illustrate features and machinery details, with gear diagrams and photos of optional equipment available for special jobs. A half page of diagrams and photos show how the crane can be loaded and unloaded for rail shipment by handling its own components, and two full pages illustrate job applications. **Manitowoc Engineering Works, Manitowoc, Wis.**

TIMBER—A booklet entitled, "Timber for Recreational Buildings," will be of particular interest to architects, engineers and builders and those in charge of construction for the Armed Services. The 24-page booklet vividly portrays the wide variety of design that can be achieved in recreational-type construction by the use of the three major systems of timber construction, each assuring a maximum of efficiency at marked economy in cost. Brief summaries of the uses of Teco timber connectors for both light and heavy structures, and Trip-L-Grip framing anchors for secondary connections in wood framing supplement the pictorial display. Also included are a listing of roof truss fabricators and a bibliography of recent lumber literature. **Timber Engineering Co., 1319 Eighteenth St., N.W., Wash. 6, D. C.**

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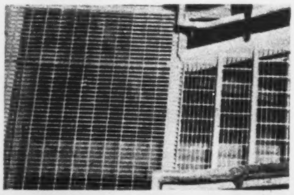

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Closed to Further Discussion

21. **Maximum Load Capacity of Bailey Bridges** by Robert B. Stegmaier, Jr., Jun. M. ASCE.

22. **Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy,** Progress Report of the Committee of the ASCE Structural Division on Design in Lightweight Structural Alloys.

23. **Influence of Heavy Loads on Pavement Design Trends** by K. B. Woods, M. ASCE.

24. **Summary of Buckling of Rigid-Jointed Plane Trusses** by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman.

25. **Uplift Pressures in Concrete Dams** by Kenneth B. Keener, M. ASCE.

D-XVI. Discussion of Paper, **Stream Flow Variability,** by E. W. Lane and Kai Lei.

D-XVII. Discussion of Paper, **End Restraints on Truss Members,** by Harold E. Wessman and Thomas C. Kavanagh.

D-XVIII. Discussion of Paper, **Frequency Analysis of Beam and Girder Floors,** by Hans H. Bleich.

D-XIX. Discussion of Paper, **Roads and Pavements, Sampson Naval Training Station,** by Jacob Feld.

D-XX. Discussion of Paper, **Aerodynamic Theory of Bridge Oscillations,** by D. B. Steinman.

26. **Industrial Stream Pollution Abatement,** by L. L. Hedgepeth.

27. **Plasticity of Metals—Mathematical Theory and Structural Applications,** by D. C. Drucker, Assoc. M. ASCE.

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30. **Economic Effects of Reservoir Sedimentation,** by W. E. Corfitzen, M. ASCE.

31. **Measurement and Analysis of Suspended Sediment Loads in Streams,** by Martin E. Nelson and Paul C. Benedict.

32. **Effect of Skew Angle on Rigid-Frame Reactions,** by Walter C. Boyer.

33. **Strength of I-Beams in Combined Bending and Torsion,** by Basil Sourochnikoff.

34. **Lateral Buckling of Eccentrically Loaded I-Section Columns,** by H. N. Hill and J. W. Clark.

35. **Design Curves for Footings on Soil,** by Winfield A. McCracken.

Summarized in Earlier Issues

D-XXII. Discussion of Paper, **Analytical Method of Determining the Length of Transition Spiral,** by Michael V. Smirnoff.

D-XXIV. Discussion of Paper, **Diversion Tunnel and Power Conduit of Nantahala Hydroelectric Development,** by D. J. Bleifuss.

36. **Impossibility of Performance in Contracts for Engineering and Construction,** by Robert F. Borg.

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38. **Hydrology of Mexico,** by Andrés García-Quintero.

39. **Practical Design of Solid-Barrel, Reinforced-Concrete Skew Structures,** by Bernard L. Weiner.

40. **Technique of Passing Floods Over Earth Dams During Construction,** by Andrew Weiss.

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41. **Ship Response to Range Action in Harbor Basins,** by Basil Wrigley Wilson.

42. **Wind-Load Standards in Europe,** by John W. T. Van Erp.

43. **Settlement Correction at La Guardia Field,** by John M. Kyle.

44. **The Problem of Wave Action on Earth Slopes,** by Martin A. Mason.

45. **Comprehensive Plan for the Columbia Basin,** by William Whipple.

D-4. Discussion of Paper, **Capillary Phenomena in Cohesionless Soils,** by T. William Lambe.

D-5. Discussion of Paper, **Elastic Restraint Equations for Semi-Rigid Connections,** by J. E. Lothers.

D-10. Discussion of Paper, **Pollution Abatement Policy,** by Thomas R. Camp.

D-XXIII. Discussion of Symposium, **High-Velocity Flow in Open Channels.**

D-XXVIII. Discussion of Paper, **Movements in the Dessicated Alkaline Soils of Burma,** by F. L. D. Wooltorton.

Second Notice

46. **Human Aspects of Mexican Irrigation,** by Antonio L. Rodriquez. Although Mexico's arable land per inhabitant is about equivalent to areas in the United States already adequately supplied with water, its watered land is only a third as great or only one acre per person. Far-reaching plans promise improvement, largely by irrigation. From the welfare standpoint the aim is to spread development by relatively small farms, owner operated, with federally financed water supply repayable on a rational continuous basis. The purposes and encouraging results of these efforts over two decades make interesting reading. (Available January 1.)

47. **Operation and Maintenance of Irrigation Systems,** by Raymond A. Hill. A description of the problems of operation and maintenance of irrigation systems, particularly in the United States, is given in this paper. Operating procedures based on deliveries of water in accordance with natural flow rights, on demand, in rotation, and on advance orders are discussed. Causes of operating waste are described and the need for measurement of water is emphasized. It is pointed out that efficient operation of irrigation projects depends on the maintenance of all storage, diversion, distribution, and drainage works in good condition at all times. Various maintenance problems are described, and attention is called to the need for more efficient equipment. (Available January 1.)

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48. Compaction of Cohesive Soils: Progress Report of the Subcommittee on Consolidation of Materials in Earth Dams and Their Foundations of the Committee on Earth Dams of the Soil Mechanics and Foundations Division. In this report the subcommittee reviews the present status of the compaction of cohesive soils in earth embankments with regard to laboratory practice, the compaction of fills, the compaction requirements as related to design, and the performance of completed fills. In doing so it is pointed out that laboratory testing in its present state does not necessarily set the compaction requirements for a fill, nor is there precise correlation between laboratory compaction and the compaction achieved in the fill. (Available January 1.)

49. Large Hyperbolic Functions Computed by Fission, by F. T. Llewellyn. Hyperbolic sines and cosines are often required in the solution of cubic and quartic equations encountered in structural analysis. The primary object of the paper is to simplify this work for adaptation by practical designers and computers. The method is more precise than that of interpolation by proportional parts, and adequate precision is attained much more readily than by academic methods. Examples for solution by slide rule are included. (Available January 1.)

50. Supersonic Sounding Instruments and Methods, by Joseph M. Caldwell. The historical development of echo sounders is described, together with the comparative advantages of portable versus fixed, sonic versus supersonic, and recording versus indicating types of echo sounders. The action and reliability of echo sounders over various types of bottoms and with surface wave action are discussed from factual test results obtained under normal operating conditions. Numerical comparisons of simultaneous soundings taken with lead-line and echo sounder are presented for both firm bottom and soft bottom conditions. (Available January 1.)

D-27. Discussion of Symposium, **Design Characteristics of Lock Systems in the United States: A Symposium.** The original symposium, published in January 1950, presented the latest thought regarding the design of locks and other navigation structures. Discussers are: Basil Standing, and Frederick Griffin. (Available January 1.)

D-2. Discussion of Paper, **Public Utility Condemnation Cases in the State of Washington,** by Henry L. Gray. The original paper, published in February 1950, described the problems entailed in the condemnation cases in the State of Washington. The author argued for the improvement of engineering techniques in this field. Discussers are: H. D. Southerland, Jr., and Henry L. Gray. (Available January 1.)

D-3. Discussion of Paper, **Treatment of Foundations for Large Dams by Grouting Methods,** by A. W. Simonds, Fred H. Lippold and R. E. Keim. The original paper, published in February 1950, discussed the experiences gained in grouting the foundations of twenty or more large dams. The material is presented under three main headings—foundation grouting equipment, grouting materials, and foundation grouting procedures. Discussers are: A. Mayer; V. L. Minear; Byram Steele; James B. Hays; and A. W. Simonds, Fred H. Lippold, and R. E. Keim. (Available January 1.)

D-9. Discussion of Paper, **Atchafalaya Diversion and Its Effect on the Mississippi River,** by Leo M. Odom. The original paper, published in March 1950, explained the diversion of flood waters from the Mississippi River via the Old and the Atchafalaya rivers in Louisiana as an important factor in the control of the Mississippi River floods below the point of diversion. Discussers are: E. F. Salisbury, James F. Halsey, Jere W. Higgs, and Leo M. Odom. (Available January 1.)

First Notice

51. Laterally Loaded Plane Structures and Structures Curved in Space, by Frank Baron and James P. Michalos. Two analytical procedures—in the form of analogies—are developed for structures continuous between two supports. Results are interpreted in terms of a pressure line concept. A "shear and torsion analogy" is presented for arches, bents, and balcony girders loaded normal to their plane. Assumed moments are balanced by correction moments computed as shear stresses in an analogous strut. A general procedure is developed for structures curved in space and loaded in any direction. Such structures may be used, for example, in urban freeway design. (Available February 1.)

52. Some Aspects of Electronic Surveying, by Carl I. Aslakson. Surveying and mapping techniques are undergoing revolutionary modifications as the result of advances in electronics. Commander Aslakson, who has been actively engaged in the development of long distance electronic measuring techniques since 1944, discusses these changes. Commander Aslakson recently reported a new measurement of the velocity of radio waves by long distance electronic measurements. His value has recently been offered by British and Swedish scientists as corroboration for adoption of a new velocity of light which is about 1 part in 20,000 higher than the previously accepted value. He also reports that such rapid advances in accuracy are being made that publication dates cannot keep pace with developments. (Available February 1.)

53. Wedge-Beam Framing, by Arsham Amirikian. Wedge-shaped members, having tapered flanges and webs, constitute elements of a new type of framing. These members are joined by an alternating series of rigid and flexible connections to form assemblies which provide appreciable economies and lend themselves to a simple analysis. The paper contains suggested arrangements of framing, details of connection and a method of analysis. As an aid in design, the analysis is reduced to the formulation of a series of simultaneous equations involving a limited number of redundants, which are set directly, through tabular guides, and their solution is obtained by a simplified procedure. (Available February 1.)

54. Truss Deflections by the Coordinate Method, by Kuang-Han Chu. The method described in the paper is an algebraic equivalent of the Williot-Mohr diagram. By adopting a set of simple sign conventions and by suitable arrangement in tabular forms, the work is minimized. This method, like the Williot-Mohr method, is in many respects superior to many available algebraic methods for determining truss deflections as it determines both vertical and horizontal components of the movements of all joints in a truss. Moreover, it is preferable to the graphical Williot-Mohr method in that it can be carried to any degree of accuracy. (Available February 1.)

55. Measurement of Sedimentation in Small Reservoirs, by L. C. Gottschalk. The standard field practices of the Soil Conservation Service, in the assembly of sedimentation data, are described. Equipment and methods of sounding for water depths and silt thicknesses are given, and surveying procedures discussed. This paper should be considered as a companion to Separate No. 50, "Supersonic Sounding Instruments and Methods," by Joseph M. Caldwell. (Available February 1.)

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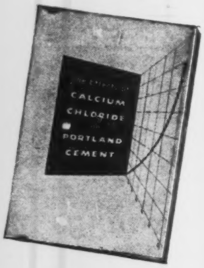

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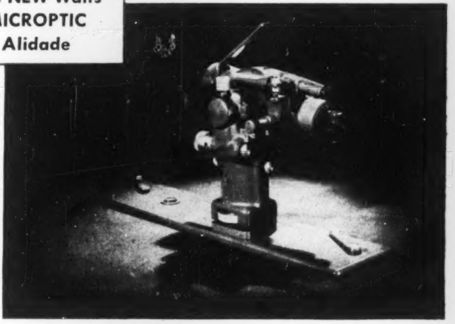

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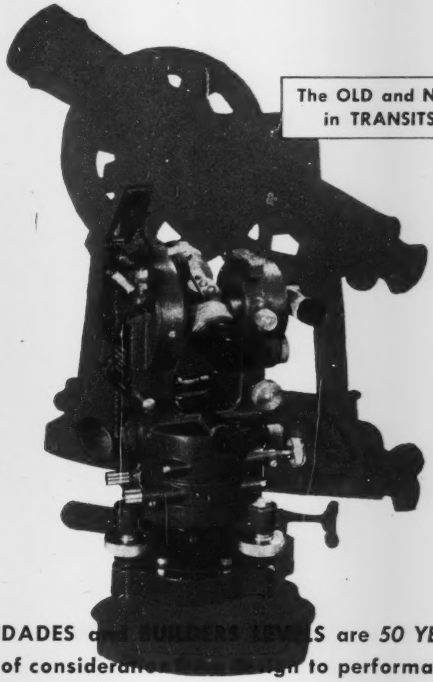

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